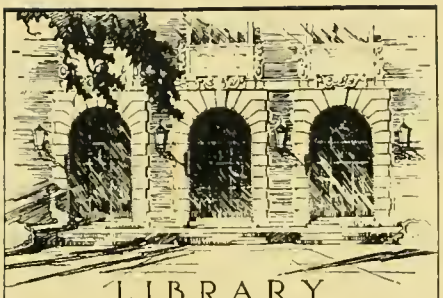

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OCTOBER
1941

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THE TECHNOGRAPH

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Published Eight Times Yearly by the Students of the College of Engineering, University of Illinois

Published eight times during the year (October, November, December, January, February, March, April, and May) by The Illini Publishing Company. Entered as second class matter, October 30, 1921, at the post office of Urbana, Illinois. Office 213 Engineering Hall. Urbana, Illinois. Subscriptions, $1.00 per year. Single copy 20 cents.

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. . . bidding you a warm welcome to Illinois

THE NEW UNION BUILDING

Our Little Job As "Campus Greeter"

By Richard W. Landon

Senior in Electrical Engineering

RICHARD LANDON

The tall, dark and handsome Business Manager of the 1941-42 Technograph voices our welcome to all who come to the campus, and draws from the record items of interest for freshmen and delegates to the National Convention of Engineering College Magazines Associated. Soft-spoken humor underlies his serious analysis of the magazine's purpose.

Well, sir, school is here again. After the work and play of the summer, it seems like quite an oddity to be coming back to a regimented life of study for some ten months. But then, all play and no work makes Jack a dull boy—literally. Some of us have been merely playing this summer; others of us have been working; still others have engaged in activities as varied as life itself. So we come back and try to change our habits to those of concentration for a while at least.

But we can't stick to school work all of the time. The result—we indulge in extra-curricular activities. We find that though we learn fundamental principles of the why and wherefore in the classroom, there is no course that can adequately teach us how to work with the people around us. Activities, however, throw us with our fellows and rather force us into learning something about men's reactions, their likes and dislikes.

In the engineering college, the Technograph, the engineer's magazine, is such an activity and has grown through the years to a position of some importance. With the rise of this magazine and others similar to it in various colleges throughout the country, there came a need for an organization of these magazines whereby they could exchange ideas of editing and management. From this need was evolved the E.C.M.A.—Engineering College Magazines Associated.

The E.C.M.A. now includes twenty-four of the larger engineering college magazines and does much to maintain the high quality of these magazines. Inducements in the way of awards and prizes are offered for excellence in articles, editorials and make-up of the magazine. Such men as Professor Richardson, President of E.C.M.A., Mr. W. B. Littell, Advertising Representative, and John W. Ramsey, Executive Secretary, have done much to maintain the high standards and progressive spirit of the organization.

Every year, the organization holds a convention at some school among the twenty-four. Last year the convention was held at the University of Arkansas; this year it is to be held here on the campus of Illinois. Need we say that Illinois is proud to be host to such a group or that the students and faculty are glad to bring such representation into their midst. This group has done much in these conventions to present the ideas of all schools and from this heterogeneous collection evolve something for the benefit of both magazine and school.

The Technograph of Illinois is one of the oldest engineering college magazines in the country. Since its inception as a magazine in 1885 it has watched the University grow from a fairly small school to one of the largest universities in the world with schools renowned to the corners of the earth for their excellence.

It has watched the engineering college start from its beginnings as the first M.E. school in the middle west to develop into the massive organization it is today with some sixteen buildings and two hundred-fifty professors and instructors. The Technograph has reported engineering events during the development of the world famous Ceramics school, the splendid Architectural school, one of the finest Chemical schools, and an engineering curriculum second to none.

Since the days when freshmen engineers were forced to walk to and from classes through the refreshing waters of the Boneyard to the present day when the University frowns on any sort of hazing, the Technograph with the E.C.M.A. has been trying to express the engineers viewpoint, to show others just what engineering is. It's watched the fabulous Red Grange, Gallopin' Ghost of Illinois, tear through an opponent's line, and more recently Bill Hapac score against any defense.

The Technograph has looked across Green Street and seen Old Uni Hall go down and the erection of the splendid Illinois Union with its vast facilities for student entertainment. It's seen many a homecoming week end with the return of many alums and the resulting festivities. It's helped in Student Engineering Exhibits and Electrical Shows and aided generally in the advertisement of the engineering college.

The magazine has been serving its readers during the time for many men to pass from instructorship to professorship to oblivion or reverence; for students to leave to make their fame and fortune, some in engineering, some in many other lines of work. It's watched Arthur Cutts "AC" Willard pass from Dean of the engineering college to the presidency of the University. It's helped advertise the advancements made by faculty and students—to show public, students and faculty the truly great things that have been developed in the University such as the "placing of sound on film," accelerating electrons, development of workable bridge formulae, and other developments too numerous to mention.

The Technograph as other magazines in the E.C.M.A. tries to give the student, primarily, faculty and alumni, secondly, news of the engineering campus, developments in and outside of the school, with a dash of wit and humor

OLD *and* NEW

Changes in the campus scene noted in the TECHNOGRAPH of past years included these buildings:

The Memorial Stadium (top) was erected in 1922-23 as a gift of alumni and friends of the University through the Athletic Association. It replaced the old Athletic Field (left) as the scene of most varsity interscholastic contests.

Center of military activity and instruction at the University is now the Armory (left) which was built in 1914-15 and was supplemented by additions in 1926-27. This structure replaced the Old Armory (bottom) which had been erected in 1889-90. The latter has been used as the Old Gym Annex since its retirement from military service.

thrown in for good measure. The Technograph has deviated from the other magazines to a certain extent in the past year, however, in developing an easy style of familiarity with the student. It is the belief of the Technograph staff that while students are interested in subjects beyond their own scope, they do not care to delve into a scientific discussion of the fabrication of refractory products when they are interested in the "why" of magnetic attractions. Thus most articles about the technical subjects are treated more as news than as technical treatises. Prominent people are presented with a view towards giving the engineer a better acquaintance with his college. (We believe this is undoubtedly the best feature of its kind on the campus.—Ed.)

The Technograph also has as its aim help for the new engineer; acquainting him with faculty, students and buildings; helping him to decide on the proper engineering courses, and in general, to develop in him a sense of just what an engineer is. All phases of engineering are presented; none are shirked, and all are praised equally.

To help advertise the college and what it stands for is its final purpose. To high schools and other colleges goes the magazine to show what Illinois is doing, to promote the college. Engineers wield the most potent forces in the world, but it takes advertising to get people to allow the engineer to use his abilities.

The staff of the Technograph is proud to be able to present this magazine of the students to the students and hopes that through the ensuing months it may present such articles as will be of greatest interest to all engineers. The Technograph invites your criticism and suggestions and will endeavor to put them to good use. We welcome you—whether you be a freshman, upperclassman, E.C.M.A. delegate, professor, or alumnus, and may you find the Technograph of 1941 good reading.

Let DIE CASTING

Solve Your Non-ferrous Casting Problems

The necessity of obtaining economical castings in quantity for National Defense focuses attention on fabrication by the die-casting process. The author presents a resume of the possibilities.

By M. Hufschmidt

Among the various processes used for fabricating metals, die casting has continued to be used to an ever increasing degree. This is due to some inherent advantage that it possesses when compared with ordinary sand casting or permanent mold casting. As a result the process has grown so that now die castings are used in a great many industries; their most important application is in the automobile and aircraft industries.

Die casting is essentially casting molten metal under pressures greater than atmospheric. For this purpose metallic molds are used. The molten metal is forced under pressure into the steel molds and allowed to cool. The molds are then parted and the completed castings removed. When taken out and examined the surfaces are found to be very smooth and free from sand inclusions and blowholes. Thus they require little or no machining, and can be used immediately, or treated by painting, buffing, or plating. Very complicated parts can be die cast; multicored castings can be made if a suitable mold can be designed, because the molten metal penetrates every part of the mold, and imparts a very sharp and finished appearance to the castings.

The die casting process is capable of producing metal parts fit for a great many uses. It is restricted to metals of comparatively low melting points. Zinc, aluminum, and magnesium are the most important metals being die cast, although brass is also being die cast in spite of its high melting point. There are no rigid size restrictions to their production; articles as small as zipper teeth and as large as automobile radiator grilles are being produced today. The present trend is molding castings, formerly consisting of many parts, as one piece, thereby saving the cost of fitting.

There are several limitations to die casting which are retarding its full development, but which are being solved by research and experiments. As a result many difficulties have already been overcome. As previously mentioned one limitation is the high melting point of some of the alloys. The steel dies now in use are not able to withstand the temperatures needed to melt some alloys; hence an improvement in die steels will result in further development of brass die casting.

Another difficulty encountered was the change in chemical composition of the alloys between melting and the finished product. Iron was being absorbed from the melting pot; this iron reduced the tensile strength and ductility of the castings so its presence in the casting was very objectionable. The molten metal was also absorbing oxygen and nitrogen from the compressed air which was in direct contact with the casting metal. This also caused the castings to be full of small air pockets, which further weakened the metal. The pouring temperature also was not high enough to keep the metal molten until it reached the furthest point in the mold. The use of low pressures in casting resulted in castings with rather low metallic densities.

The cure to most of these difficulties has been found. Improved melting pots reduce the absorption of iron by the metal. Higher pressures and new machines using the pneumatic-ram principle solve the density and air pocket problems, by removing the contact between the compressed air and the molten metal. This almost entirely removes the oxygen and hydrogen absorption. Machines have been designed to die cast aluminum at pressures around 9,000 pounds, thus improving the metallic density.

The zinc die castings are of importance in the automobile industry, where the castings are used for many parts both on the motor and the body. The castings can be produced at a low cost, because of quantity production. They have good tensile properties up to about 200 degrees Fahrenheit, but above that temperature their strength falls off rapidly. The auto industry uses about one-half of all the zinc die castings produced; this ratio has remained constant for the past ten years. The total zinc die castings production has increased four-fold in the last ten years however, showing an expansion of their use in all fields.

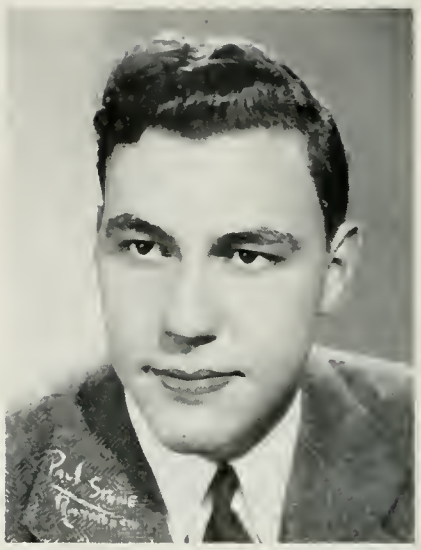
Aluminum alloy die castings are being used much in the aircraft industry today; their properties make them suitable for use as unstressed and semi-stressed members. A disadvantage still noticed is their unfavorable elongation properties; this prevents them from being used in many spots where elongation is an important factor. Die casting has saved aircraft companies much money in the past. As much as $2,000 was saved on a single plane by using die castings, while savings of 15% of sand casting and machining costs are usual.

The latest in die casting alloys are the magnesium alloys. Their distinctive feature is their extreme lightness. Magnesium is but two-thirds as heavy as aluminum, and one-fourth as heavy as steel. Although not as strong as aluminum or steel per unit volume, they have favorable mass-strength ratios when compared with them. As a result magnesium die castings are used for secondary stressed and non-stressed members on aircraft. The Dowmetal alloys EX, K, and R are samples of aluminum alloys being die cast. When machining is necessary, the magnesium alloys possess the additional advantage of machining very easily.

Brass die castings possess very good physical properties; they are resistant to corrosion and have values of tensile strengths up to 100,000 pounds per square inch, and hardnesses up to 200 Brinell. Their high melting point is the main factor restricting their production. The improvement in design of dies will overcome this difficulty.

The technical advances made in the last few years have definitely put the die casting process in an increasingly important position in industry, especially in the aircraft and auto industries. The development of new high-pressure automatic machines, which turn out die castings by the thousands, results in a lower unit cost, and thus a wider range of use. It is true that die castings are limited to non-ferrous metals of reasonably low melting points, but within these limitations the process has a great opportunity for expansion. It is the hope of the die casting industry that in a few years die casting will replace many parts now sand cast.

Engineers Appreciate Good Music Too . . .



CHARLES G. SCHOTT

A thorough understanding of music comes only from hearing it frequently. The best in music is presented by the Star Course, for which the author is Senior Manager. As an engineer he speaks from the engineer's viewpoint.

By Charles G. Schott
Senior in Mechanical Engineering

I have often heard it said that the engineer cannot understand anything other than figures and his pet slide-rule. Being an engineer myself I cannot think of any statement which is farther from the truth. However, since I have been associated with the Star Course I have noticed that only a few of our engineering students seem to possess the *understanding* necessary to appreciate good music. This is one of the very few failings which the group seems to possess, but stop and think! How many other people have that *understanding?* Relatively few!

The engineer, the same as the lawyer, the accountant, artist, or chemist, does not have that so-called understanding simply because he has not *exposed* himself long enough. If you had never come in contact with a few engineering principles or seen an engineer at work, you probably would have chosen another field in which to apply your potentialities. But you had heard of engineering many times. Perhaps your friends were interested in the vocation or your parents had an active part in it. You had been *exposed* and now you have attained through education an *understanding* of engineering.

Your understanding of music must grow the same way. An understanding of music is not developed over night, acquired from textbooks, nor is it picked up in a classroom. Music is something which grows on a person. Music is something which lives because of its own greatness. Music is the something which continues to live after man dies. Such a thing as this must be worthwhile.

Behind every classical piece of music written there is a story. "What kind of a story?" you may ask. It may be either a story portraying some incident of life, or it may be a story of the composer's emotions. Beethoven, Tchaikowsky, Haydn, and Debussy all wrote in both gay, light moods and extremely passionate ones. Knowing this background and the life of the composer will add to your understanding of each number. It is through knowing these facts that you will know what the composer is trying to display through his music. When you know what to expect you can appreciate the manner in which the work is written and presented. You can criticize and applaud—in fact you may *understand* the music. From your understanding you may then competently express your special likes and dislikes. And let there be no doubt—everyone has his special likes and dislikes about all music.

To the freshman, who desires to expose himself to this thing called music, Star Course offers a wonderful opportunity, not as a commercial organization, but as an activity of which he can be a part. He will work with music, meet the people behind it, and gain a wealth of musical information. Star Course is sponsored by the University Concert and Entertainment Board and it is in his first year the freshman may apply to them for a position on the sophomore staff. The sophomore staff is composed of fifty students, twenty-five boys and twenty-five girls. Sophomore work consists mainly of handling the office work, concert presentation, and publicity. After the sophomore year if the student wishes to go on he may apply to the board for a position as Junior Manager. Here the responsibilities increase. The Junior Managers have charge of or supervise all the work carried out by the sophomores and are responsible for the completion of such work. For your last year in school, if you were successful in being appointed a Junior Manager, you may petition for the position as Senior Manager.

Each semester Star Course presents a series of concerts for the students and faculty of the University at a nominal cost. These concerts are presented throughout the year in the Auditorium of the University. This year we are inaugurating a new system of concert presentation in celebration of our fiftieth anniversary. In the past it has been the custom to present the artists in a single Star Course series, and then to supplement this series with a Symphony Course. Now we are presenting a single series each semester which places our organization on a running basis similar to the University year.

In celebration of our fiftieth anniversary we are giving a complimentary concert to our first semester patrons which will feature the celebrated Coolidge String Quartet. It is our hope that the entire University will join us in this fiftieth anniversary celebration.

In the past few years I have had several students, freshmen as well as upperclassmen, ask me just how Star Course did get its start on the campus. It's a long story and it all started in the spring of 1917 when the University Concert and Entertainment Board was organized under the name of Star Course. It had a board of advisers consisting of the director of the School of Music, the comptroller, a member of the faculty selected by the Council of Administration with a view to acting in an advisory capacity concerning dramatic attraction, and two members elected annually by the Philomathean and the Adelphic Literary Societies. The comptroller was selected to be ex officio chairman of the board and the faculty members were to serve for two years. The managers were selected from each literary society for each season's course.

(Please see page 22)

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Left: At 6:00 A.M. the shadows are long and you are very sleepy, but the top-kick says "Battery B on the line;" Bob Johnstone (center) and Ralph Clark (right) both have that sleepy look. Center: The 3-inch AA gun recoils with a bang at Ft. Sheridan, where coast artilley cadets from Illinois trained at summer camp. Right: You tell us who is who when wearing gas masks for gas and smoke drill on the beach at Ft. Sheridan.

Oh, for the Life of the Army!

This letter is the first of several intercepted from the R.O.T.C. camps this past summer. Watch for the one to follow in the November issue of the **Technograph**, which the Editor promises is "a Lulu." The identity of "Darling" is not disclosed.

Company D, ROTC Camp
Fort Custer, Mich.

To whom it may concern,
Darling,

Sometime about the middle of June a group of tents sprang up on what had been a deserted field here at Fort Custer. In a few more days dull-colored Army trucks began hauling supplies to this section. On June the nineteenth the components of the ROTC camp began to pour in. Regular officers and non-commissioned officers from many schools arrived a few days early to complete final preparations for the organization of the camp. When the students arrived, by train, bus, car, etc., they were hauled to the camp, unloaded, registered, and sent to take their physical examinations. Having passed the physical exam, and very few didn't pass, they were issued equipment and assigned to tents.

The first big problem to be settled was the placing of equipment in the tents. Some thirty-five or forty separate articles and pieces of equipment had to be adjusted and put away in accordance with camp regulations. Within the first few days each man knew where everything should go and had become accustomed to placing it there. It isn't at all like home, Darling. The process of learning this placement was somewhat speeded up by numerous tent and area inspections. Gee, they are more strict than your housemother!

Camp duties began immediately after the equipment had been issued. The rifles were all packed in wooden cases, ten to a case, and each rifle was carefully and individually packed in several pounds of cosmoline. Cosmoline is a peculiar sort of grease which has the property of drying and leaving a hard varnish-like surface which is almost impossible to remove. Cleaning this grease from the rifles required gallons of gasoline, many men, and a great many hours of hard work. After completing this preliminary cleaning the grease kept oozing from the cracks whenever the gun stocks became warm. The rifles did not attain good condition for several days. Mine is slick as a whistle now.

The beginning of our actual instruction was more in the line of review and orientation than an effort to learn something new. For the first few days the time was occupied with close order drill, extended order drill, setting-up exercises, general instructions in camp rules and regulations, and final adjustment of all the myriad details connected with starting an organization such as this. Darling, they really made us work. Wasn't that mean?

The fourth day of camp we took up the packing of the army haversack and bed roll. (Did ya' ever see a bed *roll*, huh?) The general idea is to take all the essentials for a march of several days and so pack them together as to be readily accessible and comfortable to carry. The equipment carried included a blanket, shelter half (one half of the standard army pup tent,) tent poles and stakes, toilet articles, items of clothing such as a raincoat, change of underclothing, extra socks, mess equipment, canteen, and emergency food supplies. The complete army pack weighs approximately sixty-five pounds, more than half as much as you do. When it is properly packed and adjusted to the body of the soldier it is not especially uncomfortable or difficult to carry. That's what they *told* me anyway.

Extended order drill and instruction in general combat principles and scouting and patrolling occupied several hours of each day for the last half of the first week. During the progress of this instruction we made several short hikes of a few miles each practicing the various principles we were being taught.

The principle and most important instruction given during the first two weeks of camp is that given concerning rifle, sighting and aiming exercises, position exercises, practice in making the various slings for the rifle, practice in bolt manipulation and rapid fire exercises. At the conclusion of this preliminary instruction we were taken to the rifle ranges for actual firing practice. In the firing of a thirty calibre rifle the first shot is the hardest. All of us had heard so many tales concerning the recoil or "kick" of the rifle that we were more or less jittery when taking position for firing our first shots. Actually, the recoil is not bad at all. The explosion of firing the projectile is rather painful to the ear drums if the ears are not stuffed with cotton, but otherwise firing the "thirty" is no more difficult than firing the "twenty-two" calibre rifle on the University rifle ranges. I'll bet you'd have jumped too,

darling, if you heard the noise these make.

During the practice firing we fired at ranges of two hundred and three hundred yards, using all four positions, standing, sitting, kneeling, and prone, using slow fire in all positions and rapid fire in kneeling, sitting, and prone. At the conclusion of this practice period, which required about four days to complete, all cadets fired a record course in an attempt to qualify with the rifle as marksman, sharpshooter, or expert. Maybe I'll get a medal you'll like—and be a *crack-shot* instead of a *crack-pot* like Uncle thinks I am. He won an iron cross or something.

One of the more interesting side line jobs in connection with the range practice is the pit detail. This is a group of men who leave the camp about twenty minutes before the firing crew and take up positions in pits just below the range targets. These men operate the targets, mark the position and value of all hits scored, time the exposure of the targets for rapid fire, and any other duties in connection with keeping the targets ready for firing. They receive communications from the firing line through private telephone systems, one for each detail of ten or twelve targets, operated by various members of the organization.

All in all, the range firing is a lot of fun, but it gets extremely hot and the light is quite blinding on a bright day. The firing line is of sand, and when it is dry and the wind is blowing, the eyes get rather rough treatment. Protective glasses are almost a necessity. I'm getting a good sunburn.

Meals are provided by the company mess. In our organization—the Engineers, about one hundred twenty-three of us are fed in our mess hall, plus about twenty-five men from the Signal Corps. Nine men are delegated each day to serve as K. P.'s. They clean up the mess hall, wash all the dishes and silverware, and make themselves generally useful in preparing the meals. The actual food is not of especially high quality in some cases and is quite often unattractively prepared, but on the whole, the food is good enough and in large enough quantities so that a man can live on it and remain healthy. In many cases the men seem to put on weight at camp.

As to recreation, we have the whole city of Battle Creek, which is not especially well supplied with recreation, we have our own ROTC Club or Hostess House, athletic facilities are available for swimming, tennis, horseshoes, volleyball, and other such sports. In addition the Post movies are available for us and show quite good features. The USO provides shows every once in a while. They are usually of good quality and quite entertaining. I have seen only one of them, but it was excellent. Gee, I wish you were here, too.

Religious facilities are afforded by both the many churches in Battle Creek, and the various post chaplains. Services are held every Sunday morning and many of the men attend regularly. In general, the facilities are available for almost anything a person wishes to do, all you have to do is find out where it is.

As soon as we finish our rifle training we will take up the more technical engineer field problems, such as mining and demolitions, bridge construction, road construction, etc. We are all looking forward to that period with a great deal of pleasure. And I'm looking forward to seeing you before we go back to Illinois this fall—it'll be so different from the Army.

This should give you some idea of what our first ten days are like here at the ROTC Camp. I must close now and get ready for the work tomorrow. I'll write again soon. Lebewohl—Gerry.

The November issue of THE TECHNOGRAPH will emphasize military and national defense industries. Watch for it.

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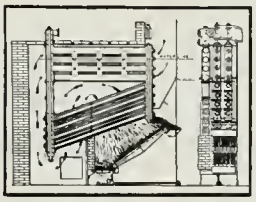

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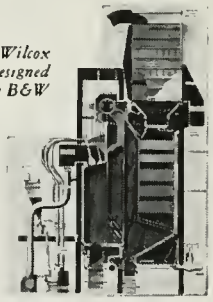

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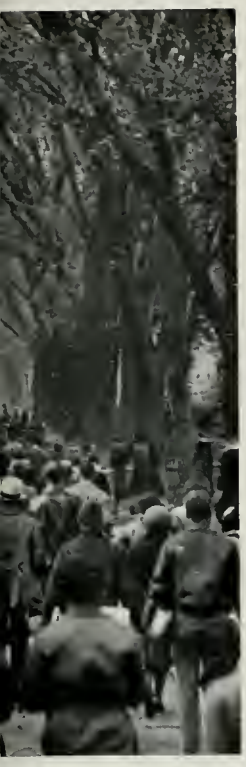
O N O U R

Above: Engineering Hall is the landmark for engineering alumni who return to the campus. The Engineering College and the Technograph are among those offices quartered within its buff brick walls.

Below: Huff Gymnasium, named for the late George Huff, famed Athletic Director at the University, is the scene of major dances in between duties as host to record-breaking basketball crowds.

Top Center: You are now among
the Broadwalk in the rush betwe
the north and south portions of th
becomes Burrill Avenue.

Bottom Center: As the hub of st
Illini Union Building sparkles lik
the front of Engineering Hall.



CAMPUS

Above: The Registrar, Physical Plant Department, President, Dean of Men, and Business Office are among the many offices in the Administration Building. Your university record and probably your life history are in the files.

Below: Illinois is proud of its library, one of the largest in the country, and the building which houses well over a million volumes is a good example of modified Georgian architecture.

ini who traditionally have crowded
ses. The Broadwalk ties together
pus. On the engineering campus it

affairs and social activity the new
em in this night scene taken from

NAMES

. . . *in the news*

By Richard W. Landon
Senior in Electrical Engineering

and Donald K. Stevens
Senior in Ceramic Engineering

BOB KUDER

Bob Kuder, senior EE, walks around the engineering campus with a continual smile and possesses the ability to make everyone like him better each time they meet him. Bob doesn't try to be likable; it just comes naturally. Partly because of this affable manner, he has been twice elected to the vice-chairmanship of the student branch of the American Institute of Electrical Engineers. Here he has done an admirable job in directing meetings, planning programs and helping in the publication of the noted "Campus Currents."

Bob lives not far from the campus in a turn of the highway near a bridge designed by some Illinois engineers. He lovingly refers to this budding metropolis as the Golden Gate of the Midwest, St. Joseph. As it's only ten miles from the campus, he drives to school every day. Living away from school doesn't keep Bob from attending the meetings of the various organizations to which he belongs including Eta Kappa Nu, honorary electrical engineering fraternity, and Sigma Tau, honorary engineering fraternity. And it's a lot of fun to get a ride home once in a while when Bob's along with his car. Funny how many people flock around Bob at the time to leave one of these meetings.

Women don't bother Bob a whole lot. Not that he won't stand outside of the Engineering Hall for fifteen minutes to see a certain little red-head pass by, but he is able to think of things engineering once in a while—judging by an excellent grade average. He hasn't managed to go gaga over anything on the campus as yet, but there's a certain little miss in Decatur that causes him to spend a good many Friday nights in driving to and from a little session with her.

BERT FOWLER

Bert hails from Centralia, came to Illinois because it was handy and has since made the kind of grades we all dream about; the kind you and I wish for but seem to eternally elude us. When we asked Bert his formula for getting good grades we were nonplussed. "Study as little as possible and have a date every night. I've averaged about six dates a week since I've been down here." From now on we're going to burn our books and never go to bed.

Bert is a member of Sigma Tau, honorary engineering fraternity, Pi Mu Epsilon, honorary math fraternity, and Tau Beta Pi, the Phi Beta Kappa of the engineering campus. He being a P. E., or rather an Engineering Physicist, is also a member of the Engineering Physicists Society.

Bert went into Engineering Physics because he found out that there is where one is offered many methods of obtaining simple solutions by long, hard, roundabout methods. It also gives him a chance to use a lot of figures, calculus summation figures, and Greek symbols that no one can understand. The basis of all this is that if you can fool the consumer into thinking you are going to a lot of work to perform such a feat as counting the lines of magnetic force in a piece of iron or counting by hand the number of inch-pounds to the fourth power to make certain moment of inertia, you can get a lot of money more easily than if you merely got the answer by a straight-forward method.

Bert and his roommate, Bob Ballard, make a great pair for a laboratory team except that a certain li'l Southerner by the name of "Alabam" is very prone to enter the conversation. They have been known to argue for fifteen minutes over her parting remarks.

PAUL FLUCKE

Paul came to Illinois from the Junior College of Kansas City, Missouri, after plunging through a Physics course down there that's guaranteed to keep sixty per cent of its enrollment from continuing with engineering pursuits. Paul managed, and possessing a deep interest in chemistry, he came here where he'd heard was one of the world's finest chem schools. He was right.

He's an independent, likes the same things you like, including the ever-popular female; God bless 'em. He didn't date much during the first semester of last year making up for lost time on those infrequent trips home, but now . . . We heard that Paul once got into hot water when he had two dates with two different girls set for the same night. We've often wondered how he got out of that.

Paul is now president of the student branch of the American Society of Chemical Engineers and also a member of the Engineering Council which he is endeavoring to help in its purpose of engineer promotion. Paul is all for the engineer and if he has anything to do with it, the engineer is going to get a greater share in the publicity of the school. The engineer is rightfully a member of one of the most powerful of the student groups, thus he should share in some of the glory.

We leave Paul, make-no-cracks-about-my-name, Fluke to his test tubes and retorts till we again see him in the Union Building some quiet evening with some lovely thing draped on one arm.

GERRY HOMANN

That solidly handsome chap in the military uniform is one Gerald William Homann, Cadet Colonel, civil engineer, scholar, activity man, and holder of more medals, prizes and awards than any Illini since the Boer War. Gerry is every inch a soldier and with it all has the ease of a general. Mattoon is responsible for his up-bringing and still proudly claims this sandy-haired, square-jawed peer of the R.O.T.C.

It's almost disheartening to the rest of the class when Gerry pulls down five-points in C.E., and none of his Tau Bete brothers would be sorry to have his high scholastic three year average. But concrete masonry and bridge truss stresses are only one phase of a many-faceted career. He's active in the "Y" and is on its board. The *Technograph* had an Alumni Department under his direction two years ago. He's a Ma-Wan-Da man and serves on the Military Council. But there is no doubt about it—military is his first love.

As captain of Pershing Rifles this year Gerry played host to the National Assembly of Pershing Rifles in August and has high hopes and aspirations for the Illinois company's future. Twice the individual champion in drill at regimental drill meets and winner of the Hazelton Medal and University Gold Medal in successive years, Gerry does not boast of his achievements.

Where the women are concerned Gerry is a one man Panzer division. Even his close friends can't tell whether he is true to a queen from Decatur, or the various belles from Knoxville, Springfield, and Pumpkin Center. He's a good dancer, clever conversationalist, and believe me, anything can happen in his presence. It will be interesting to see who he dates for the Military Ball—or is that putting him on the spot?

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In these critical times, communications play a vital part in defense. Here is how the Bell System is organized to meet its great responsibility.

American Telephone and Telegraph Company coordinates all system activities, advises on telephone operation, searches for improved methods.

24 associated operating companies provide telephone service in their respective territories.

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Bell Telephone Laboratories carries on scientific research and development for the system.

Western Electric is the manufacturing, purchasing and distributing unit.

Highly trained through many years of working together, these Bell System companies provide a nation-wide, unified service. Never have the benefits of this system been so clear as today when the country is under pressure.

TECHNOCRACKED . . .

By Donald K. Stevens
Senior in Ceramic Engineering

•

In the fall a young man's fancy turns to what he has been thinking about since spring. And that's not such a bad idea at all when one knows that the strain is proportional to the stress. Illini co-eds return to their usual haunts about this time, eager to display a case-hardened suntan and a reading knowledge of world affairs. Smooth upperclassmen and their more gullible younger brothers are ready to dodge studies and summer bill-collectors for another nine months. It's just like "one big happy family" except that the family is at war. Or haven't you heard about the popping across the pond?

And then there is that usual accumulation of army gags, most of them too stagnant for presentation here. But we did hear of the Lieutenant who said "no" to the Colonel. That was twelve years ago and he is still a Lieutenant. He hadn't heard about the sign painter who wasn't paid. Reason: he painted "Private" on the General's door.

There is the sad epitaph on the grave of a selectee—"He can't tell me what to do even if he is the sergeant." The war will definitely end in December. A fellow who never has held a job over three months was drafted the first of September.

Among the News Items:

From Fort Bragg, North Carolina, comes word that a dreamy gunner confused the girl friend's telephone number with the range elevation. Somehow the Army is asked to pay for a cow and three turkeys.

A prisoner sentenced to Sing Sing for 99 years has asked for parole because he doesn't want to be confused with a naval base. I wonder if he has considered trading off with some other parolee who is over-age. Wouldn't that destroyer?

The ordnance company who captured the tanks in maneuvers had the right idea. Smoke and tear gas won where rifles and light hand grenades could not. Doesn't that bring a tear to your eye? It did to the tank crew.

It's too bad that Lt. Gen. Ben Lear cracked down on yoo-hooing. We could have disguised intelligence officers as yoo-hooers for foreign service.

Your local draft board might defer you for work on the *Technograph* this year. It's a good activity y'know, and no one will question the value of a little magazine work for the up and coming engineer. The staff may select you for service, and if they do, the men behind the *Technograph* will find the army draft a breeze by comparison.

From *The Bridge* of Eta Kappa Nu comes a daffynition of electricity that even "Buck" Knight doesn't know. Since nobody knows exactly we can't say it's wrong anyway:

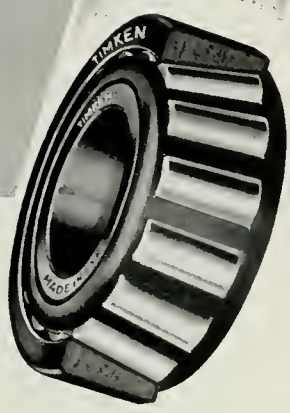
It burns your toast;
It shreds your shirts;
It pulls off buttons
And drives you nerts.
It scorches your hair;
When you need it most
It isn't there.

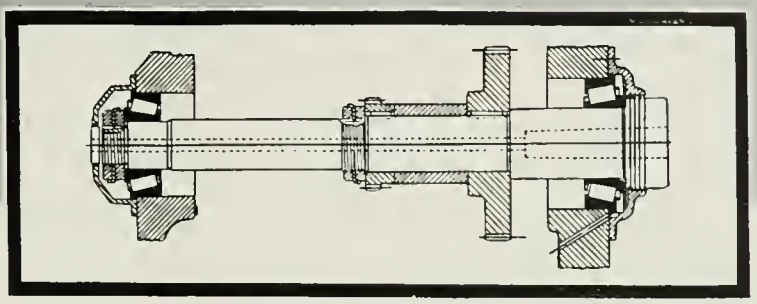
It blows a fuse;
The burner goes off,
And you catch a cold:
A six-months' cough.
In the summertime
The ice box quits,
The food is all spoils.
And the Missus has fits.

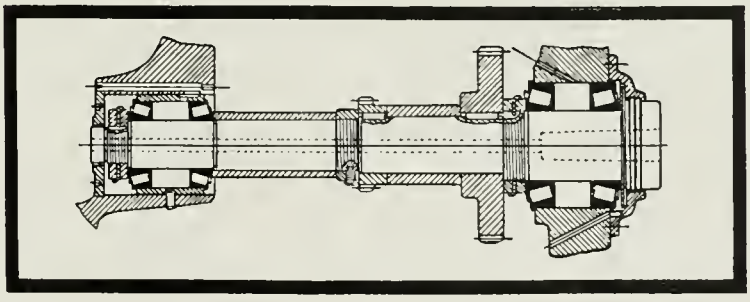
In the wintertime
Your car won't start,
The battery's frozen
As a loan shark's heart,
Again you find
Your battery dries,
Your lights go out
And your motor dies.

All of which is another way of saying that electricity is that which flows in wires, if there are any, if there is any of it.

What bearings would you specify for a Machine Tool Spindle?







Suppose you were designing a heavy-duty lathe for precision work—where tolerances as close as one ten-thousandth of an inch had to be held; where heavy cuts would be the rule. How would you mount the work spindle?

If you knew your bearings you would mount the spindle on TIMKEN Bearings front and rear. Then you would be assured of permanent spindle rigidity; freedom from chatter under any cutting load; any spindle speed; any rate of feed. In other words, *accuracy*. The spindle would turn smoothly because there would be no friction to hamper its movement. Power demands would be lower. Radial, thrust and combined loads would be carried safely under all operating conditions.

By following the above procedure you would be doing what an overwhelming majority of the leading heavy-duty machine manufacturers have been doing for a long time.

If you would like to know more about the application of TIMKEN Bearings in all kinds of machine tools as well as in many other kinds of equipment write for a free copy of the Timken Reference Manual. Know your bearings—be a better engineer.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

Manufacturers of TIMKEN Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; TIMKEN Alloy Steels and Carbon and Alloy Seamless Tubing; and TIMKEN Rock Bits.

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What better proof of the accuracy and reliability of tools bearing the world-famous "G.T.D. Greenfield" trade mark shown above?

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GUESS WHAT?

Up on the wilds of the engineering campus behind the E.E. Lab. is a most curious fountain. I'm not kidding. A circular wall as high as a freshman's head and 25 feet in diameter (slide-rule approximation) surrounds a square column of tin which projects about five feet above the rim. From this column pours a perpetual stream of fooey green water which rushes to the bottom and maintains several feet of liquid within the walls at all times.

What is this aquatic shrine or thing-amajing? Nobody in the vicinity seemed to know exactly, 'cause I got some very queer answers. The four-foot wire fence above the wall is evidently to keep something out. The large pipe encircling the wall just inside the fence smacks of big industry. Certainly it is nothing an L.A.S. man would know anything about.

Some say this fooey fountain is supposed to purify water and that the green stuff inside is on tap in all the engineering buildings—huh, huh—that's not for me. The stuff doesn't look too good to drink. Still, in a fountain it might look pure, and taste is no criterion down here.

Perhaps it's an eternal spring some engineer once tried to harness and failed; there are several disconnected fittings about. But then, that's just another theory. It appears we haven't gotten to the bottom of the solution.

This is the place you come in—or go out—or both. Cast your critical eye on the gadget the next time you pass that way. Write a few accurate descriptive lines properly describing this fooey fountain—why and what it is—and for the best description the winner will receive a free subscription to this year's new Technograph. The judges' decision is final and a duplicate prize will be awarded if necessary. To get to the point—what is the fooey fountain?

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Green and Wright Phone 6-1369

What do you know about electricity?

Check the correct answers to the questions below and see how many of these Westinghouse engineering activities you know

LIGHTNING EXPERIMENT

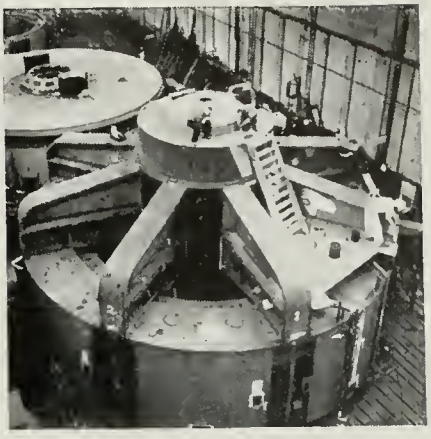
Recently, a Westinghouse engineer sat in his car while a 3,000,000-volt bolt of artificial lightning struck it. He was safe because the car body acts as:

1. *A Helmholtz bell*
2. *A Faraday cage*
3. *A Maxwell's demon*
4. *A Wilson cloud chamber*

MASS SPECTROGRAPH

This mass spectrograph, used by engineers at the Westinghouse Research Laboratories, performs one of these functions:

1. *Sorts atoms according to mass*
2. *Reveals spectra of stars*
3. *Produces U235*
4. *Measures amount of oxygen in air*



BIGGEST GENERATORS

Pictured above during construction is one of the three largest water-wheel generators in the world. All three are Westinghouse-built. Each will produce 108,000 kva, and is made for:

1. *Boulder Dam*
2. *Passamaquoddy*
3. *Dnieperstroy*
4. *Grand Coulee*

MECHANICAL MAN

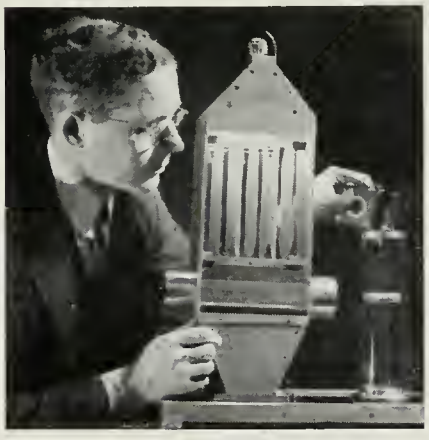
This is the latest of a series of mechanical men made by Westinghouse engineers. He walks, talks, smokes cigarettes, raises his arms, counts on his fingers, distinguishes red and green lights. His name is:

1. *Volto*
2. *Mephisto*
3. *Elektro*
4. *Sambo*

FAST X-RAY

Westinghouse research engineers have developed a motion-stopping X-Ray that operates in:

1. *200th of a second*
2. *40th of a second*
3. *100,000th of a second*
4. *1,000,000th of a second*



PRECIPITRON

The Westinghouse Precipitron removes 95% of the solid matter from the air, including particles as small as pollen, microscopic dust, and smoke. It works by:

1. *Law of inverse squares*
2. *Capillary action*
3. *Infiltration*
4. *Electrostatic attraction*

HOW DID YOU DO?

Here are the answers. If you got 4 out of 6 of these Westinghouse activities right, you did O.K. If you got 5 out of 6 right, you deserve a cum laude. If you got all of them right, you're amazing.

Westinghouse

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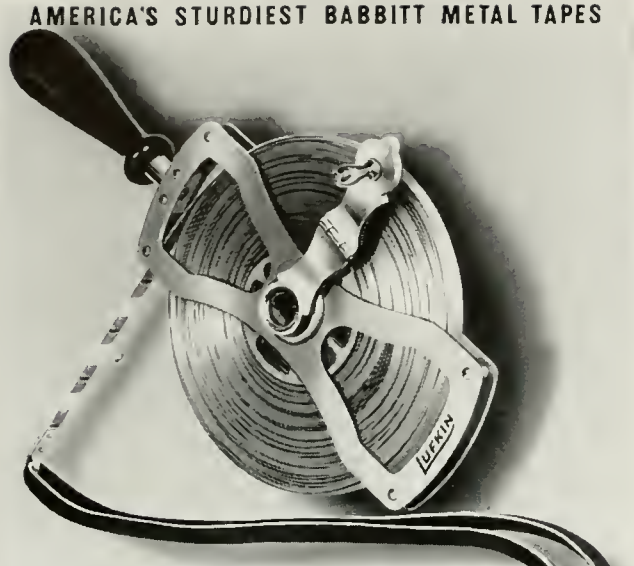
Lightning Experiment . . . A Faraday cage
Mass Spectrograph . . . . . Sorts atoms according to mass
Biggest Generators . . . Grand Coulee
Mechanical Man . . . . Elektro
Fast X-Ray . . . 1,000,000th of a second
Precipitron . . . Electrostatic attraction

AMERICA'S STURDIEST BABBITT METAL TAPES



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CAMPUS BARBER SHOP

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FOR FRESHMEN ONLY . . .

New Illini in the class of 1945 will find the usual perplexing problems of registration and orientation first on their docket. To the end of proper registration and avoidance of complications Dean Jordan suggests that the budding engineers "take things as they come and follow directions." Most difficulties of sectioning and filling out the long study lists will arise from students who try to take unusual courses, get certain instructors, and otherwise attempt to "be different." The best advice is to pay attention to signs and verbal instructions, and no "cure all" is advertised or available.

Among the many suggestions offered by upperclassmen for the benefit of the new registrants are the bits of wisdom included below. "Take care of your coupon sheet for Freshman Week." Duplicates are available only with difficulty from the Dean of the College. "It's wise to take in the many events listed—the lectures for mechanical details of the registration procedure, the mixers and dances for the people you meet. Remember that you will be in school with these fellows for the next few years, and need we mention the value of meeting the beautiful (?) Illini girls." You will all be facing the same problems and opportunities, and surely the recreation will be worthwhile. The upperclassmen will want to use your tickets for the social affairs, and that should be just one more reason for you to use the coupons instead of letting them have all of your fun, according to some far-sighted advice.

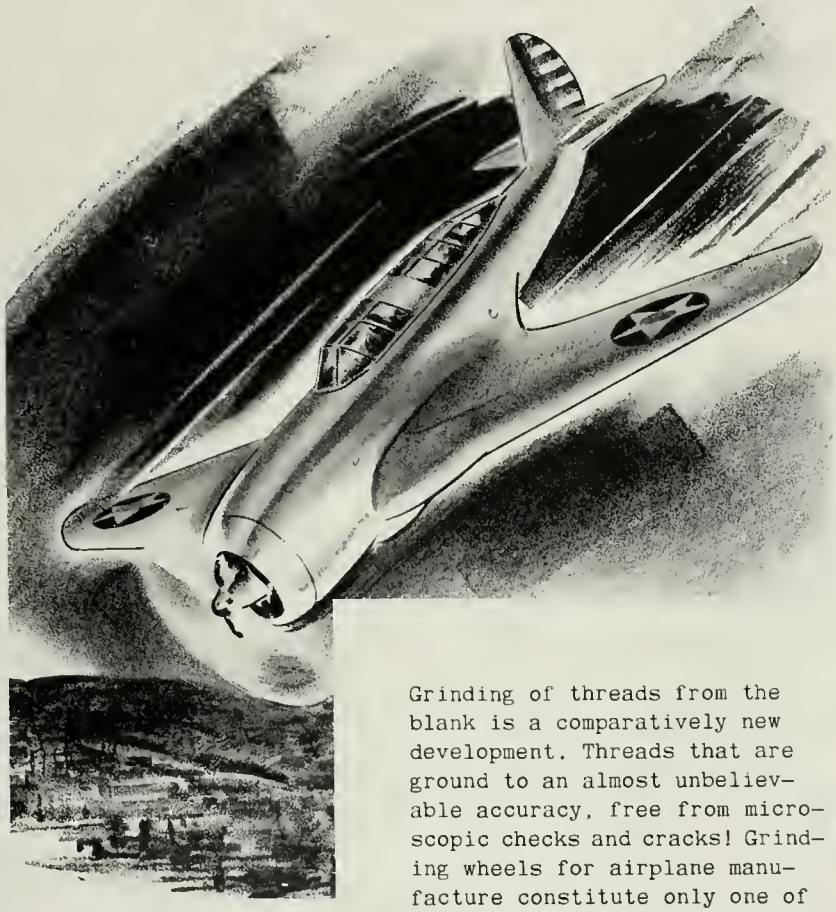
Do you know the head of your department? Some time within the next several weeks it would be entirely proper for you to introduce yourself to him at his office or on the street. Even President Willard will be glad to welcome you to his office—and he's an engineer too, so you will have common ground for conversation. Don't hesitate to speak to the society presidents when they are pointed out to you. Gerald Homann, the Cadet Colonel, is a civil engineer and he won't mind a bit if you introduce yourself to him. Donald Stevens and Richard Landon, Editor and Business Manager, respectively, of the *Technograph*, will surely be glad to meet you. All of these people will be anxious that you get off to a good start.

Naturally advisers speak of studies. They say "It would be hard to impress upon you too much the fact that the first eight weeks are most important." After all, we are all here to get a little preparation for engineering, and the advice of many engineers is "get off to a good start and you are more likely to follow through."

The usual remarks are made with regard to activities among the upperclassmen interviewed. Most of them advise the new engineering students to broaden themselves by a few well-chosen activities, and athletics, music, publications, and military are pointed out as good fields for extra-curricular interests. The Activity Night program during Freshman Week is a good opportunity to glimpse the multitude of activities available at Illinois.

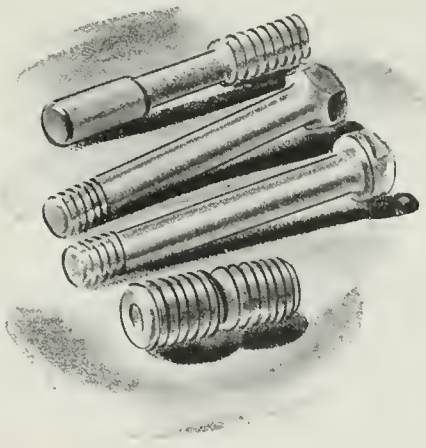
Next to the registration procedure the questions of room, board, and part-time work are usually most numerous. The Dean of Men's office is best qualified to answer any such questions which have not already been covered in the pamphlet "Your First Year at Illinois." (The latter publication is available without charge in the Information Office of the Administration Building.) During fraternity rushing the advantages of fraternity life are presented to rushees, and MIDA points with pride to its growing program of service to independents. Hence the upperclassmen and facultymen say it's up to you Mr. Engineer, to listen and then make your own decisions.

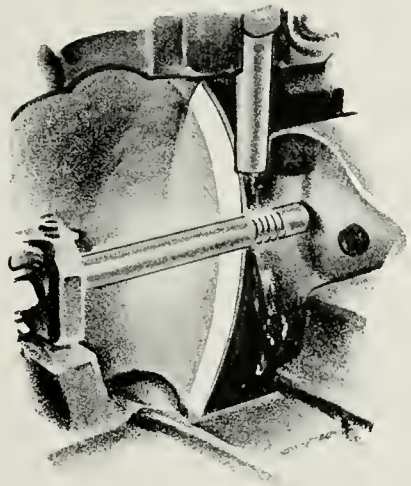
What holds a dive bomber together at 500 M.P.H.?



The answer is design and construction and materials and craftsmanship. But accuracy and finish of parts are also important in building a plane to withstand terrific speeds and that depends on grinding. Vibration is minimized by grinding all moving parts of the power unit to extreme accuracy. Safer and stronger threaded parts are ground with special grinding wheels such as are made by The Carborundum Company.

Grinding of threads from the blank is a comparatively new development. Threads that are ground to an almost unbelievable accuracy, free from microscopic checks and cracks! Grinding wheels for airplane manufacture constitute only one of many contributions made to industry by Carborundum during its fifty-year existence.





In fact there isn't an industry that has not been benefited by grinding. No matter what industry you go into after graduation, you may run into a grinding problem. And Carborundum Engineering Service will be ready to help you solve it! The Carborundum Company, Niagara Falls, New York.

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ENGINEERS APPRECIATE MUSIC

. . . from page 8

In 1929 the University Concert and Entertainment Board was created to take over the Star Course and its related activities. The function of this board was to supervise all concerts and public entertainment given in University buildings wholly by professional artists, lecturers, orchestras, and other professional individuals and organizations. The membership of the board was changed to four faculty members and four students. This board was also instrumental in electing a senior student manager for each year and such junior managers and sophomore assistants as were considered desirable. In 1933 the board elected a senior woman to assist as associate manager.

The University Concert and Entertainment Board has brought the very finest of cultural entertainment to the campus. To see and hear these great artists in metropolitan centers would probably cost several times the price for which they may be heard here. But this is the advantage of hearing music in an educational setup. Nor is the Star Course the only opportunity for the engineer to broaden his musical education. The University bands are noted as the world's finest, and the glee clubs, University chorus and orchestra enjoy growing popularity. Even participation in dance bands and "barber-shop quartets" bring musical experience of value. It is our sincere hope that you will expose yourself to the best in music. From your exposure will come understanding, and in music, and engineering, too, it's understanding that counts. The rewards of enjoyment are inevitable.

Roommate: "Hey Tom, wake up! There's a guy in here stealing your clothes!"

Second Roomie: "So what? You two just fight it out among yourselves."

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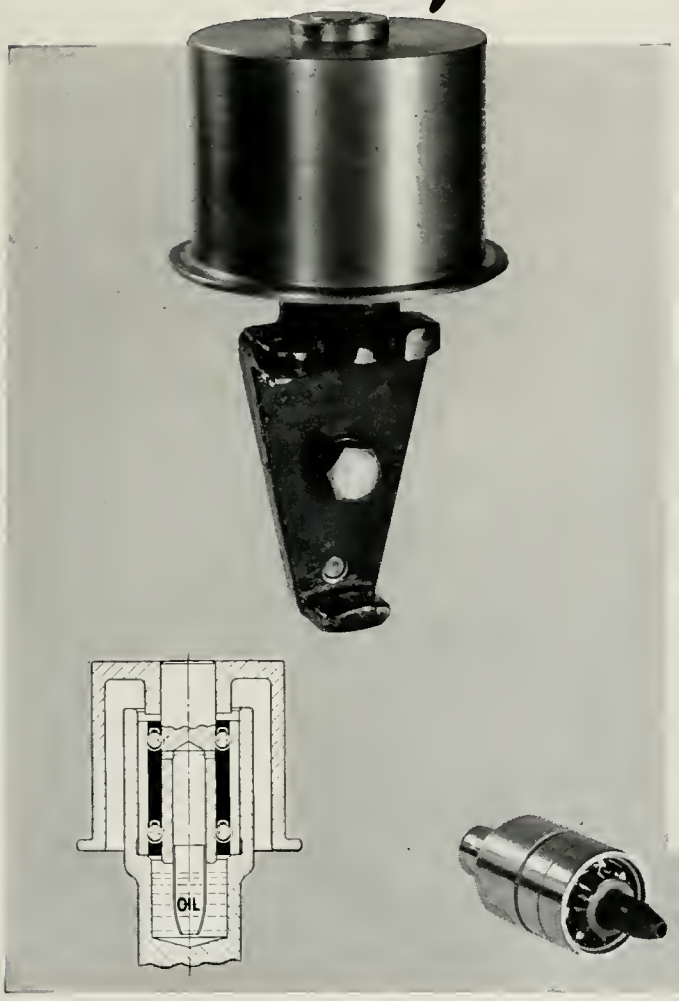

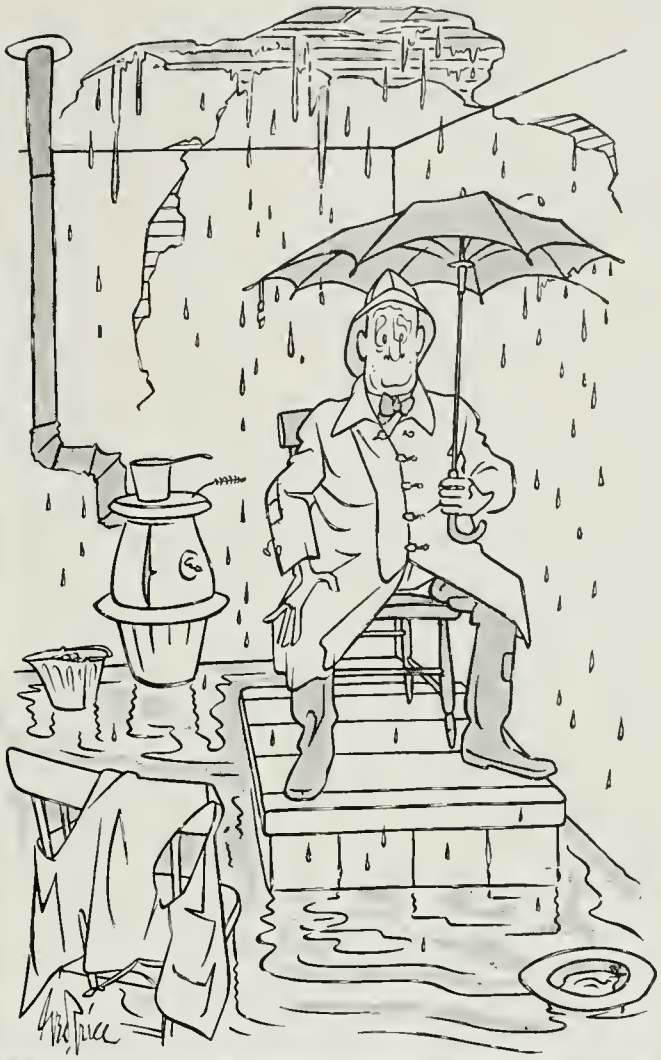

• Yes, a continuous shower of tiny drops of oil inside this Tension Pulley Ball Bearing keeps balls and raceways automatically lubricated. It is the *first* anti-friction bearing with its own oil-circulating system—a permanent built-in feature, enabling it to run for a year or more without attention.

Since the products of New Departure are *ideas* as well as ball bearings, this company has developed many "famous firsts," has revolutionized mechanical design in many industries.

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New Departure

. . THE FORGED STEEL BEARING

G-E Campus News

I KNOW!

IF THE steel for an automobile travelling between Chicago and Los Angeles at 60 mph was cold-rolled at a speed of 42 mph, how far is it from Bangor, Maine, to Bankok?

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G-E motors to the tune of 11,400 hp respond to the precision control of G-E amplidyne circuits in driving the rolls of the mill at this speed.

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G-E television engineers, however, circumvent weather changes by housing the antenna within an electrically heated box. This prevents seeping moisture from freezing on the antenna during cold weather and interfering with the normal patch of high-frequency current flow.

The antenna, at the top of a 128-foot transmitting tower in the heart of Schenectady, relays the picture waves to G.E.'s main transmitting station in the Helderberg hills 12 miles away.

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RESEARCH INC.

HOW a heavy English bulldog and a brawny Irish washerwoman substantiated the findings of years of research is described with an order for fifty miles of Formex wire recently received by General Electric.

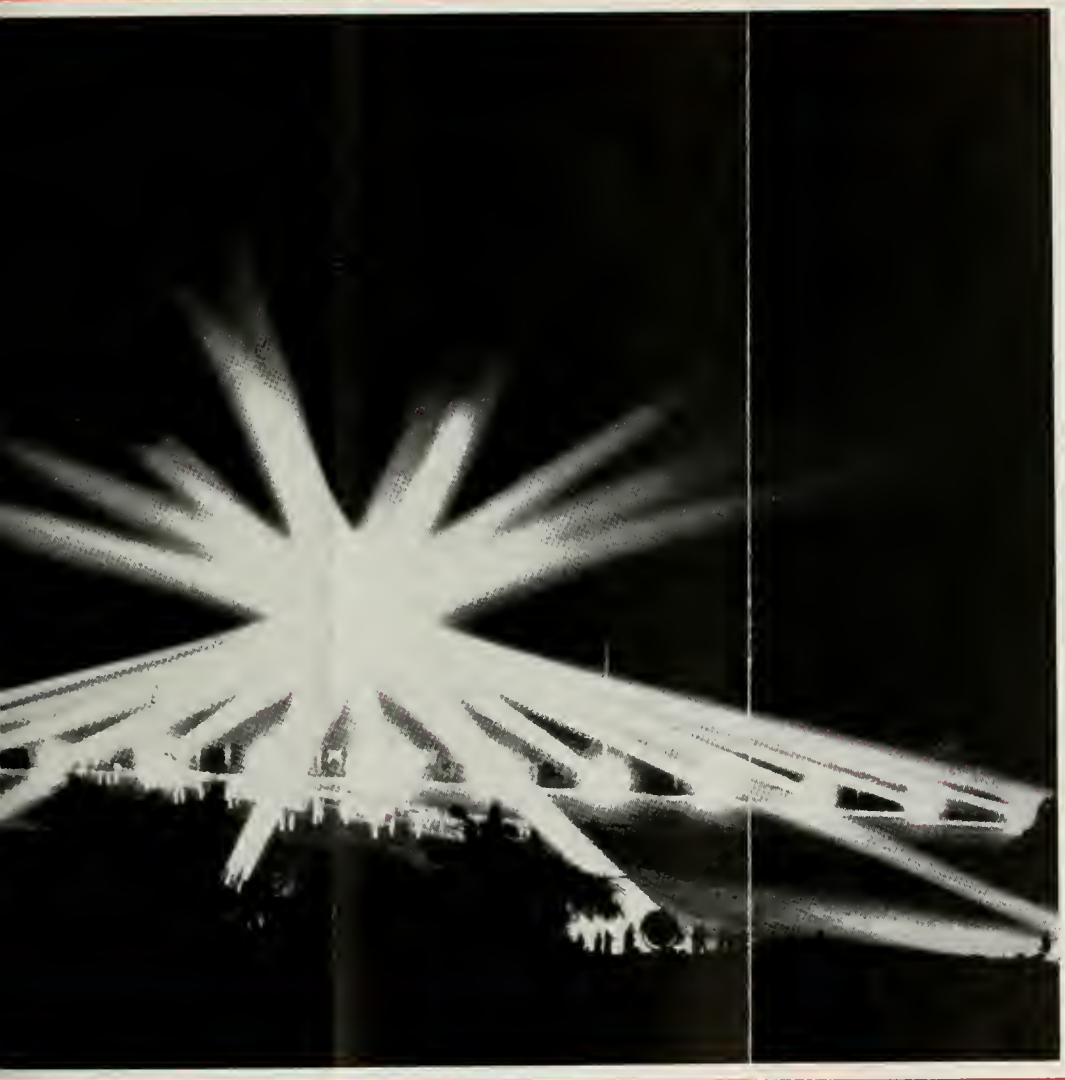
The customer was considering the use of Formex wire as a substitute for wire whose insulation had rotted after two or three years of use, exposing the bare copper. The railroad's signal engineer was "from Missouri" and wanted to see for himself whether Formex wire insulation could "take it."

Two 50-foot lengths were strung up. One was equipped with a metal ring, to which a bulldog was attached on a leash. The other became a washerwoman's clothesline. Several weeks later, after the bulldog had tugged against every inch of his wire and the washerwoman had pinched her wire with clothespins from end to end, the insulation of both lengths was still in perfect condition.

GENERAL ELECTRIC

968-24-211

ILLINOIS TECHNOGRAPH



November
1941

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West Point of the West

Military Transport

Names in the News

Illumination

Technocracked

Canada's Defense

•

Left: Searchlights at Ft. Shafter (T. H.)
U. S. Army Signal Corps Photo

olished 1885 Member E.C.M.A.

20¢

MOUNTING POWER FOR ALLIED WAR BIRDS

THIS engine mount destined for overseas service on an American made fighter plane is being fabricated by the best known method of joining metal — that is, by welding. For welding makes equipment a homogeneous, permanent unit, light yet exceptionally strong. This versatile process utilizes the Airco oxy-acetylene flame to make design problems vanish. It is applied rapidly and economically even under difficult shop and field conditions. The apparatus employed is simple, portable, easy to operate. » » So versatile is the oxy-acetylene flame, so varied are its useful applications in the metal working field, that it has long since been drafted into service to speed defense by swiftly cutting metal to close tolerances, by hardening metal surfaces for longer wear, by cleaning them for faster, longer-lasting paint jobs, and by gouging metal with amazing speed and accuracy.

The interesting booklet "Airco in the News" shows pictorially many ways in which Airco products and processes are being used to help industry speed up production. Write for a copy.

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NOVEMBER, 1941

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Published Eight Times Yearly by the Students of the College of Engineering, University of Illinois

Published eight times during the year (October, November, December, January, February, March, April, and May) by The Illini Publishing Company. Entered as second class matter, October 30, 1921, at the post office of Urbana, Illinois. Office 213 Engineering Hall, Urbana, Illinois. Subscriptions, $1.00 per year. Single copy 20 cents.

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★ ★ ★ ★ ★

". . . that these honored dead shall not have died in vain . . ."

MEMORIAL STADIUM COLUMNS

Engineers Help Make Illinois

WEST POINT *of the* WEST

By William G. Murphy

Cadet Second Lieutenant, University Brigade

General John J. Pershing once called Illinois the "West Point of the West" in a letter, and we, as engineers, should be proud since engineers take a more active part in the ROTC unit than any other college. In this connection it is interesting to note that the curricula at the United States Military Academy is almost the same as the curricula offered in the college of engineering.

In the eight top ranking cadet ratings at Illinois we find that five of them are engineers. Heading the list is the Student Colonel Gerald Homann C.E. '42, who will guide the reinforced brigade of Illinois to another of its long string of successful years. John Adkins E.E. '42, leads the Signal Corps unit of the cadet corps; Howard Schmidt M.E. '42, leads the Horse-drawn Field Artillery while Ray Carlen Met.E. '42, commands the Engineer Corps; and little Don Stevens Cer.E. '42 has the big guns of the Coast Artillery to play with this year. All are Cadet Lieutenant Colonels.

The military affairs of the campus are handled by the Executive Committee of the Military Council, on which sit eleven members. Six of these are in the engineering curricula.

The Engineers are the third largest unit in the brigade totaling 726 out of the 4,243, but they make up for their position by making the other units move to keep up with their records in efficiency and drill. The corps always has an outstanding drill team and they have won the inter-unit rifle match since its start.

The Signal Corps depends upon electrical engineers for its members. Following are the cadet ratings for this semester in the Engineers and Signal Corps: Cadet Captains: Engineers; Frederick J. Brockob, Virgil A. Burch, Edward J. Corman, Vernan H. Evans, Francis A. Een, Glen L. Gothier, Carl C. Hauser, John M. Hess, Morris B. Joslin, Mark N. Knight, Arnold N. May, Arnold Mazzucco, Elio Passaglia, Raymond C. Pownall, Pryor N. Randall, Vernon L. Rugen, Lester H. Schneider, Eugene Vermillion, Robert N. Whitaker, William W. Wuellner; Signal Corps; Verne R. Hatch, Thurman R. Hamman, John H. Behrens, Joseph F. Collins, George S. Jerden, Donald F. Maholm, Calvin W. May and Rudolph H. Tolts.

Cadet First Lieutenants: Engineers; Richard W. Bailey, Richard V. Chase, Joseph F. Chinlund, Robert G. Espy, Francis A. Flaks, George G. Gavin, Carl W. Goepfert, John C. Larson, Homer M. Lefler, Fred D. Logan, John W. McIntosh, Robert L. Polk, John P. Roedel, Thomas F. Wright, Andy Yuskanich, Edward J. Zasada, Robert J. Zastera; Signal Corps; Marshall H. Poole, James S. Thale, Fred S. Howell, Robert Helms, Robert Schardt, William Fitzwater, Bobbie P. Walker, Raymond A. Schick, and Edward L. Hulla.

Cadet Second Lieutenants: Engineers; Dale V. Addis, Robert J. Alexander, Kenneth L. Bandy, Harlan D. Bareither, Wallace E. Baas, Jack D. Boggs, Raymond H. Bohman, James B. Bramlet, John R. Carroll, Mark S. Christensen, Hilmar B. Christianson, John R. Davis, Robert C. Fairbain, Everett C. Gregory, Raymond Hamburg, Allen M. Hennegoen, Warren E. Henericks, Richard H. Horning, William E. Kellam, Clyde E. Kesler, William T. Kizevich, Raymond V. Koehler, Arnold F. Kohlert, Edward J. Krueger, Roger K. Larson, Ralph L. Lippincott, George M. Long, William A. Marenech, James B. Meek, James Mihalopoulos, Warren I. Mitchell, Robert E. Moore, Charles R. Olsen, Jack Pallister, Arthur T. Pope, Russell F. Priebe, Lloyd E. Reeser, Donald L. Renich, Frank A. Rough, Edward L. Rzepecki, Kenneth D. Sauder, Earl L. Scheidenhelm, Oliver R. Schmidt, Milton B. Sheffield, Clifford Alan Sheppard, Paul A. Simmons, Earl R. Smith, Charles L. Turner, Frank S. Wylie.

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(Please See Page 17)

T. A. M.

Makes the Big Difference

Photographs by
U. S. Army Signal Corps

By
William G. Murphy

Above: Half-trac Scout Car can "take it."
-Courtesy of White Motor Co.

IN MILITARY TRANSPORTATION

The war in Europe has made everyone conscious of the recent developments in the transporting of troops and weapons, and the question in the minds of all is, "What is America's answer to the rapid strides being made in the mechanization of the modern soldier."

Our first completely mechanized unit was organized in 1933, but to the military observer mechanization is not new—the general public has just become more conscious of it. During the first World war much of the troop movement was aided by the old, reliable Mack truck, and every front line infantry regiment was supported by its own light and medium tanks.

Speed and co-ordination are the two new aspects of troop tronsportation whether it be a mast moving attack by a Panzer unit or the massing of infantry near the front in personnel carriers. American mechanical engineers are proving their superiority everyday by developing new vehicles and improving the old so that our armies cannot be surpassed in equipment by any other. The modern developments in short wave transmission have facilitated the co-ordination of movements even though the units be miles from their bases.

What was once a tank is now a combat car and the modern tank is a land-going battleship. Our army has a light tank capable of 50 mph. on good road and 35 mph. cross country. It is driven on full tracks, has a revolving gun turret, and room for a crew of five men. Its armament consists of a 37 mm cannon in the turret supplemented by a cal. .50 machine gun, 3-.30 cal. machine guns, and one .45 cal. machine gun.

The new medium tank, only a few of which are complete, weighs approximately 40 tons, is propelled on full tracks and has two movable turrets and one gun platform. This is the new M3 which has a 75mm cannon, a 37mm cannon, a .50 cal. machine gun, and 2-.30 cal. machine guns for armament. It is capable of 25 mph. cross country. The design of this tank has already been modified but the specifications are confidential.

Experiments are being conducted on a design for a heavy tank which is a combination of the German 70-ton dreadnaught and the 85-ton descendant of the British World War I land battleship. The weight will be approximately 75 tons but the construction data is still strictly confidential.

The old tank has been developed into a fast moving,

Left: M3 Medium Tanks coming off 3 assembly lines. Chrysler Tank Arsenal.
Right: Troop B, 8th Engrs. transporting army scout car on flying ferry.

hard hitting cavalry weapon capable of 60 mph. on good roads and 35 mph. cross country. The combat car, as the cavalry terms the old infantry tank, is the most maneuverable of all the full track vehicles in the modern army.

The reconnaissance cavalry has two types of four wheel drive cars which are capable of movements in all types of terrain. The first of these is the scout car which is nothing more than a shield of 3-8-inch armor built around a chassis. The scout car is powered with a White six cylinder valve-in-head engine, weighs 7 tons, and carries a maximum load of eight men, but the normal crew is six. It has both high and low ratio gears with a maximum speed of 60 mph. on good road and 35 mph. cross country. It can climb a 30 per cent grade in rough terrain and has a roller in front of the radiator to help lift the car out of all but the steepest ditches. The 3-8-inch armor plate will protect the personnel against all small arms fire since .50 cal. projectiles lose all velocity in a point blank penetration and drop harmlessly to the floor and all angle fire will glance off without penetration. The tires are of composition which will absorb a limited amount of fire and still permit movement. The car is armed with one .50 cal. machine gun, 3-.30 cal. machine guns, 3 Garand semi-automatic rifles, and one .45 cal. sub machine gun. All machine guns are mounted on a track which permits all guns to be fired in any direction.

The second four wheel drive machine is the armored car which has six wheels and two spares mounted on an axle to facilitate the movement of the car in rough terrain. This car is completely enclosed in armor plate with a revolving turret mounted with a .50 cal. machine guns and also mounting a .30 cal. machine gun. The armored car resembles the tank without the endless track and is capable of 60 mph. on good road and 35 mph. over rough terrain.

Motorcycles are used more in scout and reconnaissance movements than attacks and may be used normally to maintain contast in column. The machine used is a twin cylinder motor built to government specifications and mounted with a .45 cal. machine gun in the center of the handle bars.

The small "mechanical horse" being manufactured by the Ford company is being used for almost everything. Its four wheel drive and small size make it capable of almost anything a horse can do, and it is harder to ride than any horse.

In order to mass troops quickly for an attack and to hold a position taken, troops must be moved with as much speed as possible. For this purpose there have developed a number of personnel carriers. Everyone has seen the 1 1-2 ton truck which will carry 12 men on seat boards. These seat boards can be removed to carry supplies.

In addition we have the half-track carrier and the four wheel drive carrier which resembles the scout car. Each of the latter have armor plate to protect the men against small arms fire and are heavily armed.

The gun units of the various organizations are being equipped with prime removers, enabling weapons and the crews to be transported at a pace which will enable them to accomplish support of the other units. Many of the smaller weapons carriers are of the "jeep" or mechanical horse type with a four wheel drive and two gear ratios enabling the crew to get the gun into the most difficult positions. The Field artillery uses large half-track movers to get its guns and crews to the point of action.

All war is not troop movement and scouting activities for all machinery tends to break down now and then, and troops must be fed and supplied. A system of maintenance has been developed in motorized columns. If the vehicle which has stopped due to mechanical failure cannot be fixed by the crew and section leader, it waits for the platoon maintenance men, and if they find after examination that they cannot repair the machine, the crew waits for the company maintenance truck. Each units has a maintenance personnel better equipped than the next smallest unit, and

Above: Trucks crossing bridge constructed by Co. A, 107th Engrs. in one hour and 20 minutes—Length of bridge, 72 ft.

Below: Tank Corps crossing pontoon bridge. Hannawa Falls, N. Y.

in the larger units complete tool and machine shops are carried with the column.

The Engineers are developing new equipment carriers to enable them to carry their bridge section and pontoons with more speed and facilitate the uninterrupted advance of the fighting troops as much as possible. Among these is an all-aluminum pontoon carrier and a bridge section mover.

Another of the recent developments is the placing of the field kitchen on trucks which enable the cooks to prepare food on the march, and serve mess to the men immediately when halting to eat.

The big difference between the German or British machines and ours is the complicated machinery. Germans fear the coming of winter because the cold weather will cut down on the efficiency of their weapons by ice, snow, and mud getting into the hinges and joints. Another different characteristic of both the German and British weapons carriers is that they are carried on the movers, thus necessitating more load on the rear wheels and making additional machinery for putting the guns into action on the trucks.

The French had a 1939 model Somua tank which even the Germans admitted to be the best in the Battle of France.

From this brief discussion of the newest types of motorization it is evident that the American engineer has been preparing this country to defend itself against any invader.

NAMES

. . . *in the news*

By William R. Schmitz

Freshman in Chemical Engineering

•

JOHN McINTOSH

Getting an interview with John McIntosh is like going through a research laboratory. John stays at a home that was set up by the Institute of Boiler and Radiation Manufacturers. And to anyone that likes Mechanical Engineering, it is an ideal place to go through. John shows you the many gadgets and equipment on the place and you wonder how he keeps it all straight. He takes daily readings and keeps track of various other data. It is a specially built house and its purpose is to make tests under actual living conditions.

John is a member of Pi Tau Sigma, Sigma Tau, A. S. M. W., Engineering Council; he is co-chairman of A. S. M. E. and president of Pi Tau Sigma. He is in the advanced course in military (Engineers) and belongs to T. N. T.

When asked why he came way out to Illinois, he said "It has a well recommended engineering school." John is an average fellow with quiet, false shyness. Since his home is in Albany, N. Y., you might expect one of his hobbies to be skiing, and it is. He also likes to hunt and to play tennis, expects to be called to military service but doesn't know just when. Sales engineering appeals to him and he lists physics and mathematics as favorite courses contributing to his 4.0 average. He'd like to work for the General Electric Co., at Schenectady, New York.

The M. E. "prexy" urges a five year course to "broaden out" the curriculum to include other than technical subjects. "One great improvement" would be to include co-operative courses in the curriculum, i. e., work six months and then go to school six months—the "Cincinnati system."

John lives alone at the research home. Lonesome?—Oh, no. He has too much work around there to get lonesome. He greatly enjoys the life tht he leads—sort of like a guinea pig a la Astor.

John Bob

BOB GROVE

Bob Grove is president of the Student Branch of American Ceramic Society. He also is on the engineering council, and belongs to MHWA, men's independent organization.

He did not take military here at the University, but played in the band instead. Thus he followed up his love for music that he found in high school. Bob lives at Mt. Carroll, Illinois, and there he sang in the boys' quartet that won first place in the state contest. He would have liked to join the glee club here at the University, but "could never find the time to spare."

Although he never played any varsity football or basketball here, he did participate in them at high school. And he lists sports of all kinds as his hobby.

To any freshman, Bob gives this advice, "Work hard when you work, and play hard when you play. Organize your time and studies so that you can get the most done." He warns that there is a hard road ahead for the frosh to travel and says not to be discouraged.

Bob has a great love for Illinois and thinks that there is no place like it. He is specializing in ceramic engineering and would like to head a personnel administration.

Our last question to Bob was "What do you think of the 'Technograph'?" To this delicate querry he replied that he liked it very much and that it was a definite boost to the engineering school. It also tended to unite the students and the faculty of the engineering department, he thought. (P.S.—We hope so too.)

BOB OWENS

Tall, brown-haired Bob Owens is a product of Blue Island, Illinois. He came to Illinois because he felt that Illinois had what he wanted. Bob thinks, and he rightly should, that Illinois has the best engineering school in the country. He is the second member of the family to come to Illinois, his sister having attended before him.

Bob is an independent, and on the sideline he buys food for a co-operative dining hall. It is up to him whether or not the rest of the boys eat. Both I. S. G. E., and the Engineering Council count him as a valuable member.

Bob says that all freshmen should join some activity. "Usually they wait until they are seniors and then try to crowd in as many things as possible. They like to have a long list of extra-curricular activities to show at their interview for a job." But he cautions: "They shouldn't try to enter too many things, and then not do anything worthwhile in any of them."

He is reputedly a pretty good dancer, and enjoys attending as many dances as possible, also enjoying tennis, ice-skating, and trumpeting. He only plays the trumpet for his own "amazement," not for other people's.

In looking toward the future, he'd like to get into sales engineering work. However, Bob is registered under the selective service law and is deferred until school is out. He may try to get a commission in the navy, although he is not certain about this. His opinion on world affairs is that it is only a matter of time until Hitler will be defeated by his own people.

Bob is a general engineer and doesn't want to specialize too much. He wants to have the background of engineering in order to be able to go out and sell engineering products. He has an average of 3.5 . . . his favorite subject: Machine Design and Shop Work.

As a typical engineering student, Bob really enjoys life at the University. When he first came here, he felt that the place was too big. But since then he has come to feel

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Telephone lines are life lines. They carry the communications so vital to our expanding defense program.

The photograph shows wires being made into a telephone cable. Such cable—containing billions of feet of this wire—is being rushed by Western Electric to meet the urgent telephone needs of the armed forces and of industry.

So too, in vastly increased quantities, are being sped telephones and switchboards—and radio apparatus for the air forces and the Signal Corps.

The efficiency of Bell Telephone service is more than ever essential to government and business, and now as always Western Electric can be counted on to supply the life lines.

Western Electric *. . . is back of your Bell Telephone service*

differently, and feels that he is more of a part of the school. He gets "a big kick" out of the social life here at Illinois. He finds girls very friendly and he usually gives them a "break" by dating once a week.

BILL MALLOY

Wm. C. Malloy is better known to all his friends as "Pat" Malloy. The nickname came about because as he says, "I was just Irish enough for 'Pat' to be a natural nickname." Pat hails from a town named Dahinda, Illinois. That name was given to it by the Indians, and it means "behind the hills." (Aren't we all?)

Pat is a member of A. S. M. E., of which he has been treasurer, member of publicity committee, and is the co-chairman for the coming year. He is on the executive cabinet of the interfraternity council; member of Phi Eta Sigma, freshman honorary society; Sigma Tau; and is President of Triangle Fraternity.

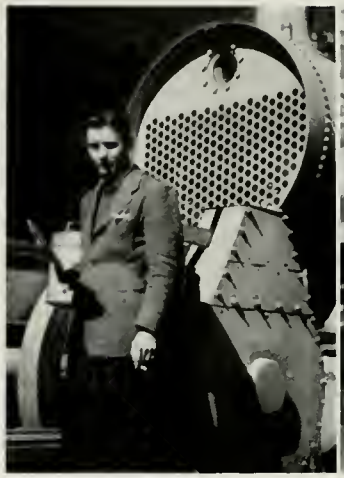
When asked for his reason for coming to Illinois, he replied, "I wanted security." Pat had worked at various part-time jobs after he had left high school and he couldn't find anything permanent. He said that he could picture himself being driven from one job to another the rest of his life, and that did not appeal to him. He believed that he would like to be an engineer, and because Illinois has "one of the finest engineering schools in this part of the country," he came here.

Thinking the M. E. course too narrow he suggests courses in economics, industrial management, history, and literature should be included in the curriculum of Mechanical Engineering. "There is too much theory and there are not enough practicable courses.", Unquote.

When questioned about Illini feminity, Pat says "The co-eds here at Illinois can't be beat anywhere." He has not settled on any certain one as yet, usually having dates during the week ends and an occasional coke date during the week. (Let the girls beware!)

Sporting a 4.0 average, Pat is doing very well in his studies we think, and find he favors Machine Design, laboratory courses, T. A. M., and Mathematics. His studies don't take all of his time and he hobbies his spare time with reading, meeting people, campus politics, and rifle shooting.

The Pratt and Whitney Aircraft Co., at East Hartford, Conn., employed him last summer, and after his graduation he hopes to go back there—especially to the experimental test department.



Bob Owens

Bill

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933.

Of The Illinois Technograph published eight times a year (Oct., Nov., Dec., Jan., Feb., Mar., Apr., and May) at Urbana, Illinois for October, 1941.

State of Illinois } ss.
County of Champaign }

Before me, a notary public in and for the State and County aforesaid, personally appeared Richard W. Landon, who, having been duly sworn according to law, deposes and says that he is the business manager of The Illinois Technograph and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management and the circulation, etc., of the aforesaid publication, for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations.

That the names and addresses of the publisher, editor, and business manager are: Publisher, Illini Publishing Company, University Station, Urbana, Illinois:

Editor, Donald K. Stevens, Urbana, Illinois.
Business Manager, Richard W. Landon, Champaign, Illinois.

That the owner is the Illini Publishing Company, a non-commercial organization, whose directors are Fred Siebert, F. H. Turner, Cecil A. Moyer, A. R. Knight, Betty Lou Gibson, Joseph Rarick, James Felt, and Dean Wessel.

RICHARD W. LANDON, Business Manager

Sworn to and subscribed before me this 15th day of October, 1941
(SEAL)

ALICE SMITH, Notary Public.

NAMES IN THE NEWS . . .

for October featured the four seniors below. We thought you'd like to SEE them.—Ed.

Bob Kuder

Paul Flucke

Bert Fowler

Gerry Homman

ZINC

Good Soldiers!

When the Country Calls, The Zinc Industry Responds

THE Zinc industry cheerfully and willingly accepts its share in fulfilling the present program for National Defense, just as it has always, year in and year out, given prompt, capable and efficient response when called upon to serve the needs of individuals and industry.

The present emergency brings with it an unprecedented demand for Zinc. Directly and indirectly, the requirements for National Defense involve the use of hundreds of thousands of tons of this indispensable metal. At the same time, the civilian industry demand is constantly increasing.

The real recognition and appreciation of the value of the service which Zinc renders comes at times like the present. Back of the metal itself, is the great industry that produces it—the miners, the smelters, the fabricators. All are bending every effort to meet not only the nation's needs for Zinc, but also to cover current production for civilian use. Production has been raised to record-breaking figures, and still the output increases. Consumers in every field are assured that the vigorous efforts being made by the industry to balance supply and demand will be sustained.

The American Zinc Institute continues to offer its cooperation to educational and extension agencies and welcomes opportunities to be of service.

AMERICAN ZINC INSTITUTE
INCORPORATED
60 East 42nd Street, New York, N. Y.

ZINC IN INDUSTRY

The essential part that Zinc plays in a multitude of important products should be understood by every well-informed technician. The location of ore deposits and smelters; mining and smelting; important uses of Zinc, such as galvanizing, brass manufacture, die-casting, rolled zinc, paint pigments and many other applications—these are discussed in

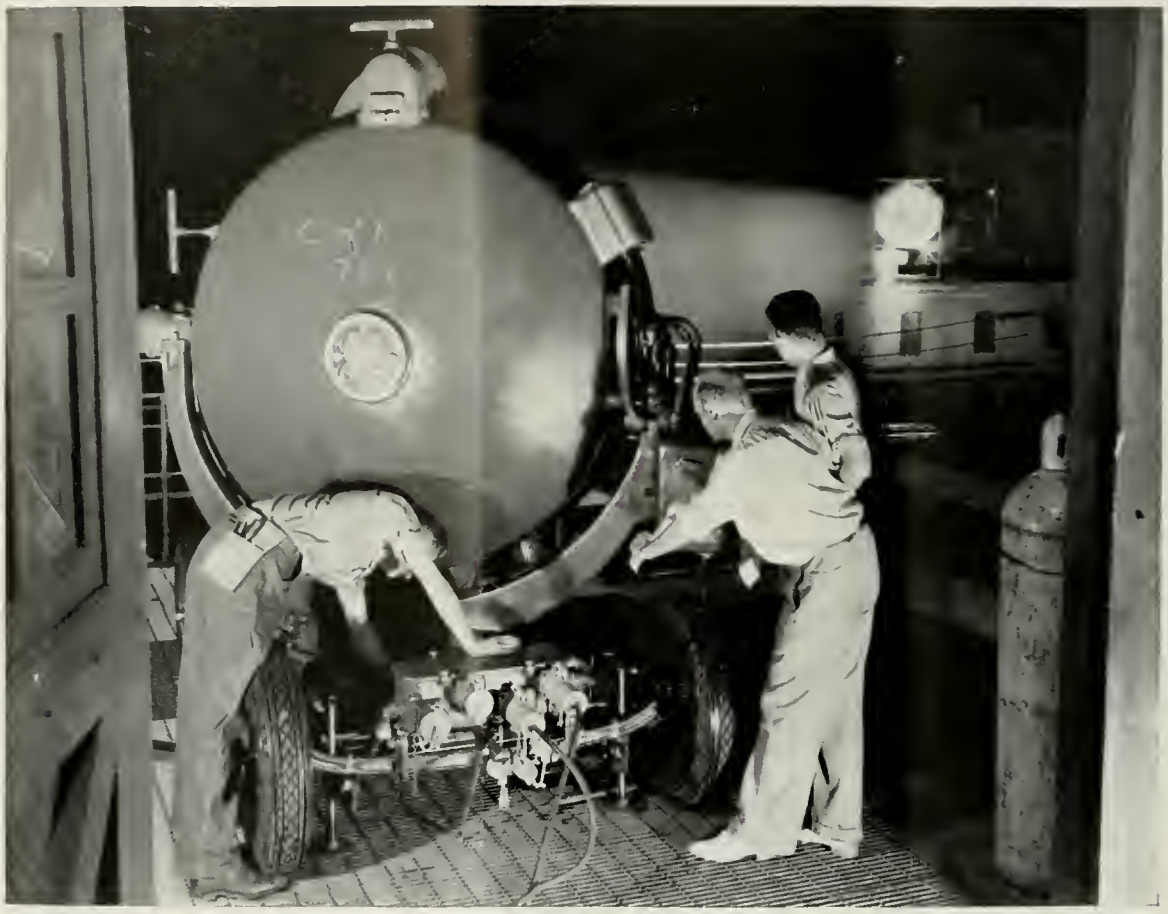
"The Zinc Industry"

a "mine to market" outline in 32-page booklet form. Important data relative to the production and consumption of Zinc are given in

"Facts About Zinc"

Copies of both of these booklets will be sent upon request.

★



Right: Every searchlight is rigidly tested by the army and the manufacturer.

★

ILLUMINATION NOW!..

By Haywood F. Talley

Darkness and quiet prevailed. Only seldom was the darkness pierced by a streak of light extending from a door quickly opened and closed by an emerging resident. Very infrequently was the ghostly silence broken by the slow, steady tread of a night sentry or by the brisk steps of a reporter hurrying to or from the offices of a transcontinental cable company. Suddenly the terrifying shriek of the air-raid alarm split the air and for seconds all the sounds that could be heard were accompanying echos and the pounding of one's own heart. The *blackout* was perfect.

Moments later the drone of enemy planes could be heard in the distance. As they drew near a person could not help but shudder with the realization that there were no doubt more enemy planes on the way than had yet attacked the capital. Long moments passed as the planes grew nearer and nearer; the roar of their engines grew louder, *Louder!* Yes, they were now over the opposite side of the city. Already the reports of several exploding bombs had been heard. As the planes grew nearer, the bombs began to drop faster and faster. The planes grew nearer, *Nearer!* In only a few seconds they would be overhead. Could nothing be done to stop them?

Almost as suddenly as the air-raid siren broke the silence, the powerful beams of several batteries of anti-aircraft searchlights flicked on to light the midnight skies. Soon it was possible to force the entire attacking command to a rapid retreat. Yes, *ILLUMINATION* made the difference.

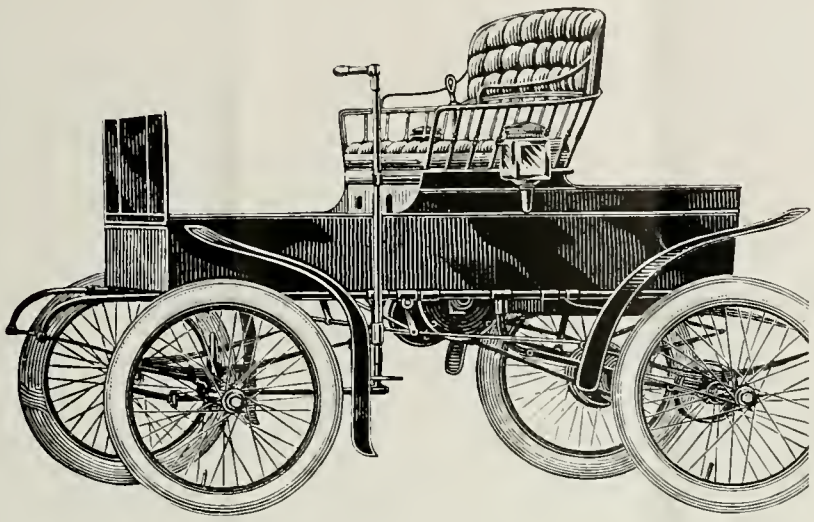
Anti-aircraft searchlights of the type pictured on the cover of this issue of the Technograph have a mirror five feet in diameter and candlepowers of unbelievable intensity. Special characteristics include high-intensity carbon arc, remote electric control, ready mobility and sturdy construction to withstand shocks incident to transportation. Each searchlight has its own remote electric control station and a light weight portable power plant with flexible cables for connecting the searchlight to its control and power plant. Each unit is complete within itself and consequently can be operated either in a battery or independently, and in neither case is dependent on an outside source of power.

The Army, Navy, and Air Corps have highly specialized lighting requirements for fortifications, naval stations, airports, seadromes, and ships, as well as extensive requirements for the lighting of camps for trainees, National Guardsmen and enlisted men. At these camps an endeavor is made to provide every needed means for maintaining the essential health and efficiency of the men, and good lighting is necessarily one major endeavor.

Some idea of the size of the Army and Navy lighting requirements may be gained by the fact that in the last fiscal year the Army bought more than 5 million incandescent lamps, 54 thousand street lamps, and ten thousand five hundred lights of special sizes or specifications. An Army cantonment of from one to five thousand troops uses more than 16 thousand light bulbs a year. An Army four-motored bomber of the flying fortress type has about two and one-half miles of wiring in its electrical wiring and power system, while a battleship carries more than 160 miles of power and control cable. A battleship of modern design has about 6,800 lamps installed in fixtures at one time, and carries two extra for each of these. This new type under construction averages 46 fluorescent fixtures among its 2,350 ceiling fixtures.

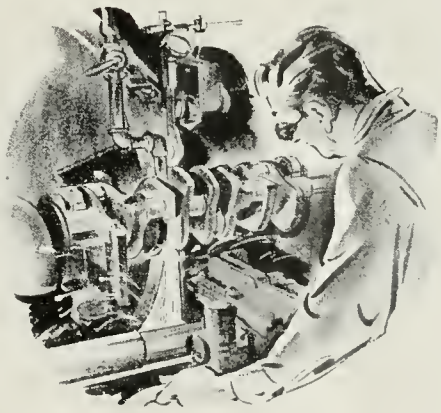
(Please See Page 17)

"No smell, noise, jolt, etc..."



"Positively the most perfect machine on the market" was the manufacturer's description of this horseless carriage in 1900. And only the rich could afford such perfection. Parts were finished by hand. Interchangeability of parts was unheard of. Then came man-made abrasives such as "Carborundum", and later "Aloxite", to help bring about the mass production that has made available to everybody that miracle of transportation—the modern American car.

The use of man-made abrasives made it possible to finish parts to uniformly close limits of accuracy. Interchangeable crankshafts, cams, cylinders, pistons, gears could be produced in quantity for instant assembly. Better-built cars became available at new low prices. And the same mass production methods extended to other products have helped bring us a new standard of living.



A leader in the advancement of grinding, Carborundum now supplies abrasive products for obtaining finishes of unbelievable accuracy. No matter what type of industry you may be identified with after graduation, you will find it profitable to use Carborundum engineering experience. The Carborundum Company, Niagara Falls, N. Y.

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EDITORIAL

HERE is a case in which opportunity practically knocks the door down. Writers, editors, illustrators, salesmen, draftsmen, typists, clerks, and anyone with a good workable idea is being urged to join the Technograph staff *now*. Did you work on your high school paper or yearbook? Many of our staff writers and editors did too, and you may want to add to your past experience as they did. Not all of our staff are old-timers at the journalism game of course—they are just enjoying the opportunities this staff offers to budding engineers.

Our magazine is one of the four publications of the Illini Publishing Company, and has been a growing concern since 1885. Matrix keys are awarded each year to students who have been active on the staff, and you can get your bronze key after this year's participation in the Technograph as an activity. You can look forward to advancement too, for ability and hard work are every bit as important as seniority here.

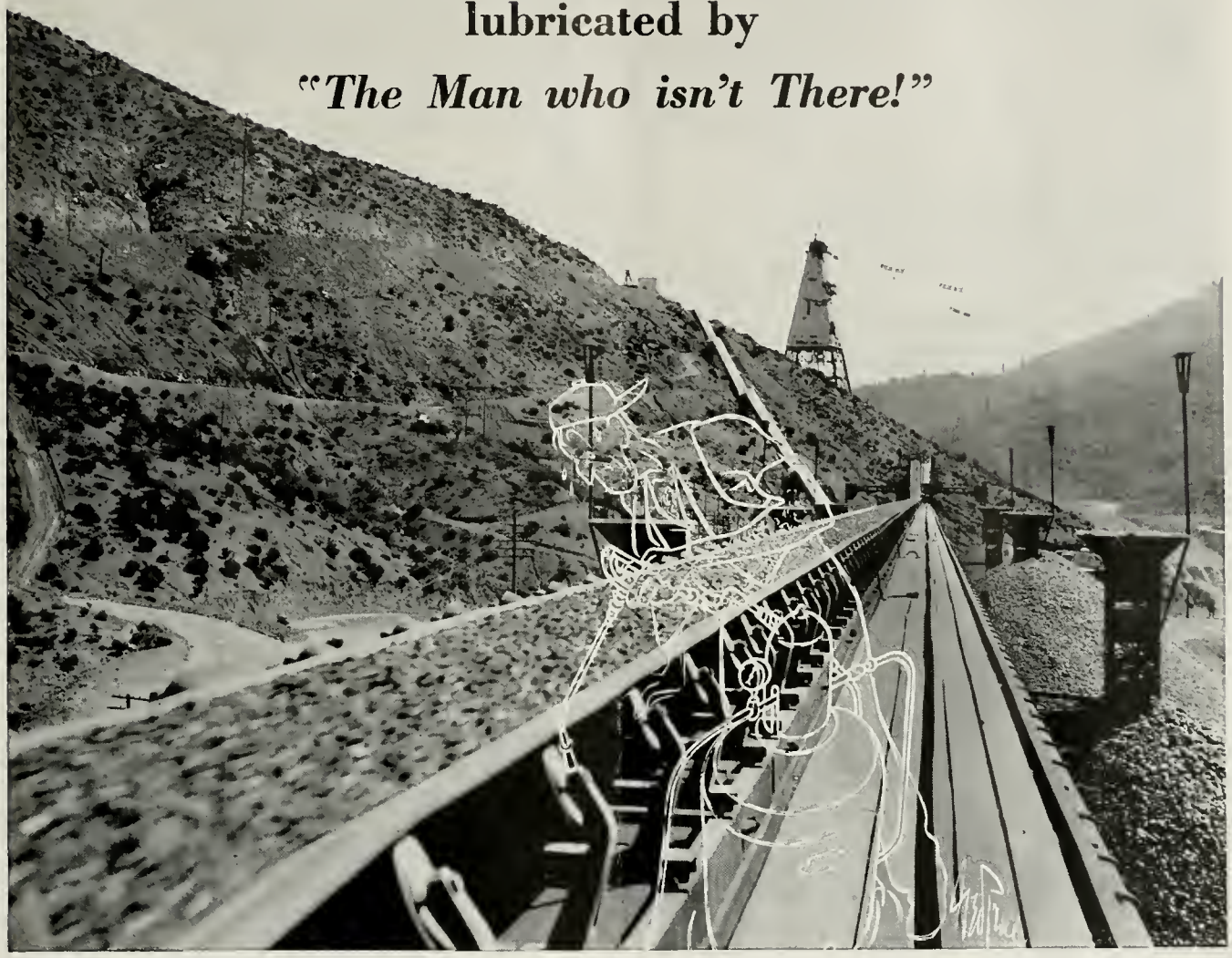
Will it take your time? Yes it will—several hours a week ordinarily, but you'll enjoy that time as much as any minutes you spend (except with the girl friend perhaps). Your name and the material you write or draw will appear in type and that's always a thrill for even the most hardened veteran.

The Technograph is having a banner year this year as host to ECMA (Engineering College Magazines Associated), so if you want to join our "family" and meet Sheldon Leavitt, Bob McCleary, Bill Cramer, Haywood Talley, August Uttich, Bill Murphy, Bill Schmitz, John Morris, Alex Green, and our new recruits, be sure to contact us. You are welcome at our office in 213 Engineering Hall, and if you have some news suitable for the engineer's consumption bring it around. We hope to restore the engineer as a man of prominence on the engineering campus, and to do that we need your help. Whether you've had experience or not get in touch with Richard Landon (Phi Gamma Delta), our Business Manager, or the undersigned who tries to edit this sheet. Just reach me at the Technograph Office or at 1210 West California, Urbana. (Phone 7-2820). If you are a freshman you may be one of the 25 we need, and if you are a sophomore or junior the door is open to you, too.

I hate to mention this, but the only cost of joining the *Technograph* staff is a little thought and time. The rewards may be pleasure, sense of achievement, improvement of your writing ability, or perhaps, as it has for a number of graduates from the staff, a better job when you enter the business world. Think it over and you'll call us right away if you are the kind of fellow we think you are . . . . a good engineer!

DONALD K. STEVENS
Editor, *The Technograph*

Mile and a-half of Conveyor lubricated by *"The Man who isn't There!"*

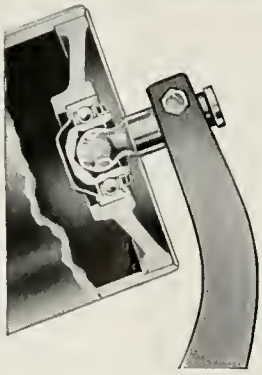


● Yes, 16,000 bearings at the Shasta Dam project, greased regularly by Yehoodi's old man—the phantom of the operation.

Seriously, the secret is New Departure anti-friction bearings, self-sealed against dirt and lubricated-for-life!

Just another "new departure" by New Departure—another "famous first" by an alert company whose products are *ideas* as well as ball bearings.

If you are to become a mechanical engineer, you just cannot escape New Departure—because these finer anti-friction bearings are used wherever shafts turn—and nothing rolls like a ball in the Forged Steel bearing.



Conveyor Bearing self-sealed and lubricated-for-life

The whole absorbing story of anti-friction bearings is told in a beautifully illustrated 112-page book we'd like to send you. Ask for "Why Anti-Friction Bearings."

New Departure, a Division of General Motors, Bristol and Meriden, Connecticut.

New Departure

THE FORGED STEEL BEARING

3046

TECHNOCRACKED . . .

By Robert E. McCleary
Junior in Electrical Engineering

•

Engineers can't understand the girls who frequent Kamerers' Annex on Daniel every night, smoking, coking and playing cards. Are they really one-semester co-eds, or are they brilliant and don't have to study, or what? Technograph may investigate the L.A.S. student sometime just for the helluvit.

Perhaps we deedn't worry—we'll all probably be overseas soon, getting our heads blown off with the rest of the boys . . . nothing like making the world safe for the Democrats, you know.

Pet peeve of Technocracked is the drawing of obvious conclusions by otherwise well meaning people, i. e., You've got a heavy date. See, you're washing up the car with gusto and hard labor, see, and some one comes by and deduces brightly: "Cleanin' her up, hey?" Gad, don't it make you smoke? Bye the bye, gentle readers, speaking of smoke, do you know any girls you'd like to see inhale? I know some I'd like to see there, too.

I wonder what it is about a cow that makes the stuff she gives so costly? She is unpretentious enough and no one would think the grass she eats and the water she drinks could finally be worth 16c per quart . . . Canny critters,

them cows. Anyway, I understand anxious parents can hardly wait nowadays until junior gets old enough to take up the whisky habit . . .

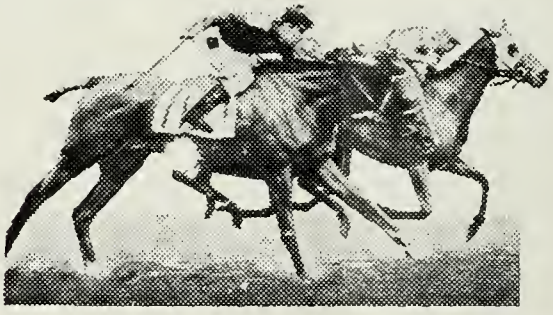
No one has forgotten the pig-roast the Ceramics threw last year. It ended up at "Bunnies" in Urbana, remember? The atmosphere became (so I am told) so murky it was hard to recognize each other under the table . . . And then the boys started singing that old gold-rush epic about "A bunch of the boys were whooping it up, in one of the Yukon halls, etc . . . *CENSORED* . . . but we can't talk about that, here.

We wonder if any of the R.O.T.C. boys at camp last summer met Maizie—you know, the one that couldn't add or subtract, but was able to work the whole division

Yoor's trooly lived in Chicago all last summer . . . . working (?) with some of the 50 odd (what am I saying) other U. of I. engineers who were employed at the Carnegie-Illinois Steel Mill . . . certainly an expensive place to live—Chicago . . . you arn't in there 15 minutes before, bang! goes another nickel for peanuts . . . a wicked place, too; people staying out until 11:30, drinking cokes and smoking cigarettes, that there new fad from down East. Nite life in Chicago seems to consist in spending money like water to obtain drinks that taste just that way . . .

Many of the seniors will take, or have already taken, inspection trips. Chem. engineers at Purdue were taken through a brewery in the East last year . . . Lucky fellows . . . It should happen to us.

We hope there will be another "Slide Rule Shuffle" this year. It gives those engineers who are exponents of "WhatchaknowJoe" jive and "Solid Sending" a chance to show off. Besides, did you ever see more beautiful women at one time than were at that dance? Engineers may not date often, but when they do, well, any old crock just won't do . . . it's got to be the best, or within certain rigidly standardized limits. (plus or minus something, you know.) On the same subject—do ceramists know more about crocks, er, ah, girls, than other engineers? We're askin', not tellin'.



Overheard a tout at Washington Park tell a friend, "I broke even on the horses today, and boy, did I need it!" . . . All which goes to prove that the only person who cleaned up following the horses was an old fashioned street sweeper . . . there really were two of them. Very good friends, broom-mates, you might say. Corny But def!

Let's make like we didn't know from nothin' and ponder about who our next president will be . . . King Franklin seems to have an "in" with our country's history. Many feel as does the Chicago Tribune (pfffttt), that while we may not get a chance to vote for Roosevelt every day, it sure seems like it. Oh well, good engineers can still get deferred . . . We should worry—those who don't like R. O., we mean.

The other day a Southerner named Smith in the T.A.M. department gave one class of T.A.M. 3 some good advice about how to arrange one's studies amidst an impending beer-bust. It was very good advice.

INSIDE DOPE

A physics professor whose initials are Donald William Kerst has whipped up a job that's called an electron accelerator. Watch Technograph for more news of this. Maybe it will put Illinois on the map . . . put it there again, we mean, of course.

WEST POINT OF THE WEST . . . *(from page 5)*

The men listed above are the leaders in the college which furnishes the military leaders to the ROTC. These men are instructed by men who have at one time or another in their career served their country as reserve officers; in fact, many of the men on the faculty of the engineering college ar still activ in military training during the summer months.

What will happen to the engineers after they leave college? Many of them will be serving their country in some way or another that we might be better prepared to defend ourselves. Some of these already have their commissions in the engineering department of the navy which will become effective when they graduate. Chick Irish, Met.E. is one of these who will be found around the high seas after graduation.

The Ordnance and munitions industry will call many of the mechanical and chem engineers either as officers in the army or as civilian aides.

Finally there will be many engineers in the new Armored Divisions which are revolutionizing modern warfare. To the organizers of this corps the training of an engineer means dependability and initiative.

ILLUMINATION NOW! . . . . . *(from page 12)*

Sufficient and proper illumination of classroom, drafting room, shop, and industrial plant also has an effect on defense efforts. Other contributory applications of defense illumination include lighting for traffic safety. Sixty percent of all traffic fatalities occur after dark, though only about one-ourth of the normal 24 hour traffic moves over the road at night. The additional traffic due to defense industries in many areas has unavoidably sent the night accident figures skyrocketing. But here, too, modern illumination methods are at work, now providing modern safety lighting for defense.

Why Worry?

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NEW EYES OF DEFENSE

By Norman Pintchuk

As the eyes of the world rest upon Hitler, the eyes of the United States Army are getting their share of attention. Throughout the many camps in the United States soldiers are using modern, precision-made intruments in the course of their daily duties. The officials in charge of buying optical instruments for use in the army and navy make sure that every instrument comes up to government specifications by checking each individual piece of equipment before it is accepted.

Both the army and the navy use many Optical instruments, but—surprisingly, the army uses a greater variety than the navy. The army uses aerial cameras, range finders, surveying equipment, telescopic gun sights, search light lenses, bomb sights, binoculars, and the French Aiming Circle. The navy, in turn, uses range and height finders, telescopes, and binoculars. In both the army and the navy, goggles for fliers are ground to suit the individual.

The cameras which are used for aerial photography are of a special design. A new type of lens was developed for the army to make it possible for them to take clear, sharp pictures from high altitudes. The size of the average negative used by the army is five by seven inches. When a photograph is taken from an altitude of five thousand feet, the images of objects on the ground are very minute and must he greatly enlarged and studied with an aerial stereoscope. This is done to get an accurate view of the objects on the ground. By this means the army can tell if an object is mere camouflage or not. After this stage, a multiplex aerial mapping machine is used. This equipment projects stereoscopic pictures showing the terrain in full detail. With this machine, contour maps may be drawn and elevations established. Necessary information is thus obtained for effective artillery control.

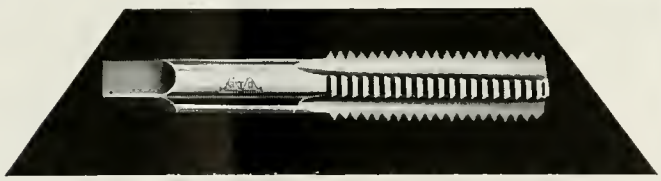
Range finders are very important because they control the fire of one-tenth of the army and all of the navy guns. The range finder that was installed on the battleship North Carolina contains more than 1500 mechanical parts including almost one hundred lenses and prisms. This construction took one-half of the total time spent in building the ship. In spite of what most people think, the range finder is a sturdy instrument. It must be air and water tight and reistant to vibration and shock.

Probably some of you are wondering how a range finder works. Well, it is very simple if you remember your geometry. The range finder furnishes the operator with one side and the two adjacent angles of a triangle, with the target at the apex. From this information and by triangulation, exact distances can be calculated quickly within the range finder itself. Final range accuracy depends on the visibility and optical and mechanical accuracy of the range finder. From this simple explanation you can see that a poorly made lens may mean a miss instead of a hit in a fight.

There are many different kinds of glass, but basically all are silicate compounds. Complex glasses have been prepared with one or more of the fluorides of potassium, sodium, and lithium. The ingredients of optical glass are mixed and weighed with the most exacting care. The pots, or crucibles, in which the chemicals are placed, are made from materials as carefully chosen as those for the glass itself. Refractory requirements are exacting. When the glass is in the liquid state it will fuse with the pot. In this way any impurities or pieces of the pot might have some effect upon the glass, and it would be inferior.

The phenomenon of refraction is responsible for the value of the glass in optics. The atomic structure of the silicate molecules is such that they will let light pass through them. If the structure is so fixed that one or more atoms are out of place, these atoms will reflect light and cause distortion in the light waves that pass through the lens. Because of this fact, cooling the glass is a very important step in the manufacturing procedure. A uniformly cooled unstressed glass is desired. After cooling, only a small per cent of the original glass is suitable for further processing, and only the portions of clear flawless glass are cut out for fine lenses.

Precision optical work means grinding and polishing to incredible accuracy. The limits which manufacturers are allowed are to within 0.0000058 of an inch. Thus you see that the temperature of the room would be a variable factor unless some steps were taken to minimize the expansion and contraction due to temperature changes. Usually the whole plant is air-conditioned. Other elaborate precautions are observed as in a watch factory to insure accuracy. From these modern optical factories, where precision is a fact and not a fancy, come great items for the nation's defense. They are really giving the armed forces new eyes for old.



A TAP *LOOKS* QUITE SIMPLE

BUT...

To make *a good tap* for a particular job may require a special kind of steel, expensive automatic machines, milling machines, accurate grinders that will finish threads to dimensions much less than a human hair, and years of experience in heat treatment.

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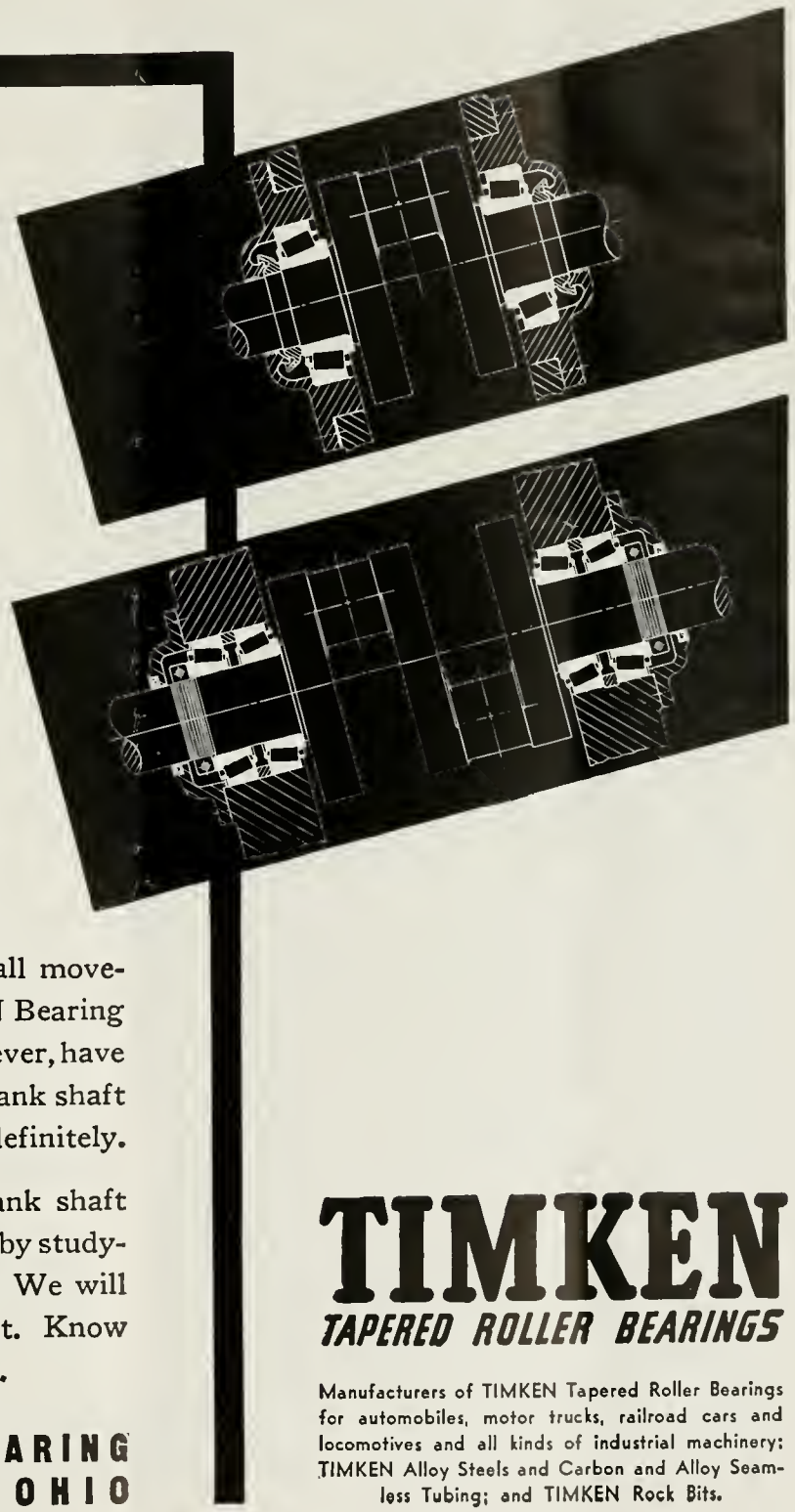
WHAT BEARINGS WOULD YOU SPECIFY FOR THE CRANK SHAFT OF AN OIL FIELD ENGINE?



If you were called upon to design a gas, Diesel or steam engine for oil field work how would you support the crank shaft? If you knew your bearings you wouldn't have to think twice. You would do as most of the leading engine builders do; you would mount the crank shaft on TIMKEN Tapered Roller Bearings—single or double, according to the length of the shaft and the H.P. of the engine.

This would assure a smoothly-operating engine that would transmit its maximum power rating to the job, for main bearing friction would be eliminated. Full protection against both radial and thrust loads would be assured. Wear on the ends of the crank shaft would be prevented because all movement takes place within the TIMKEN Bearing itself. Main bearings would seldom, if ever, have to be replaced on account of wear. Crank shaft alignment would be maintained indefinitely.

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CANADA'S DEFENSE

By Robert E. McCleary
Junior in Electrical Engineering

Is Canada doing her share towards winning this war? Canada, officially at war, has no selective service act. How extensive is her industrial support? Are we in the United States carrying the brunt of the war aid to the Allies in production? These questions bother us until we observe the records.

Production rates and the ingeniuos means used to convert Canada into an arsenal for Democracy indicate that she is definitely doing her share. Army, naval, and air force guns of latest type are now coming from Canada. These include the 'Tommies' Lee Enfield rifle, the Bren 'machine gun-rifle' (550 rounds per minute), the Colt-Browning aircraft gun used in Spitfires and Hurricanes (1,200 rounds per minute), the Boys anti-tank rifle, Bofors 40 millimeter anti-aircraft gun (120 rounds per minute up to 10,000 feet), Vickers twin mounted 5 calibre naval anti-aircraft guns (600 shots per minute), two pounder anti-tank guns, the new 25 pounder field piece, twelve pounder naval guns, and new depth charge mortars.

Also new is a Canadian built twin mounting for Lewis guns for anti-aircraft use, the gunner leaning backward in a sling during high angle firing.

In the last war, Canada had only one armament plant where only the Ross rifle was made. Today new plants are springing up, the Regina plant of General Motors of Canada Ltd. will immediately undertake 100 per cent armament production, Sorel Industries Ltd. at Sorel, Quebec, is producing the new rubber tired 25 pounder, and the Chrysler Corporation has loaned men and technicians to the great Simard Companies who, in co-operation with both British and Canadian governments, is responsible for a great part of Canada's ordnance production.

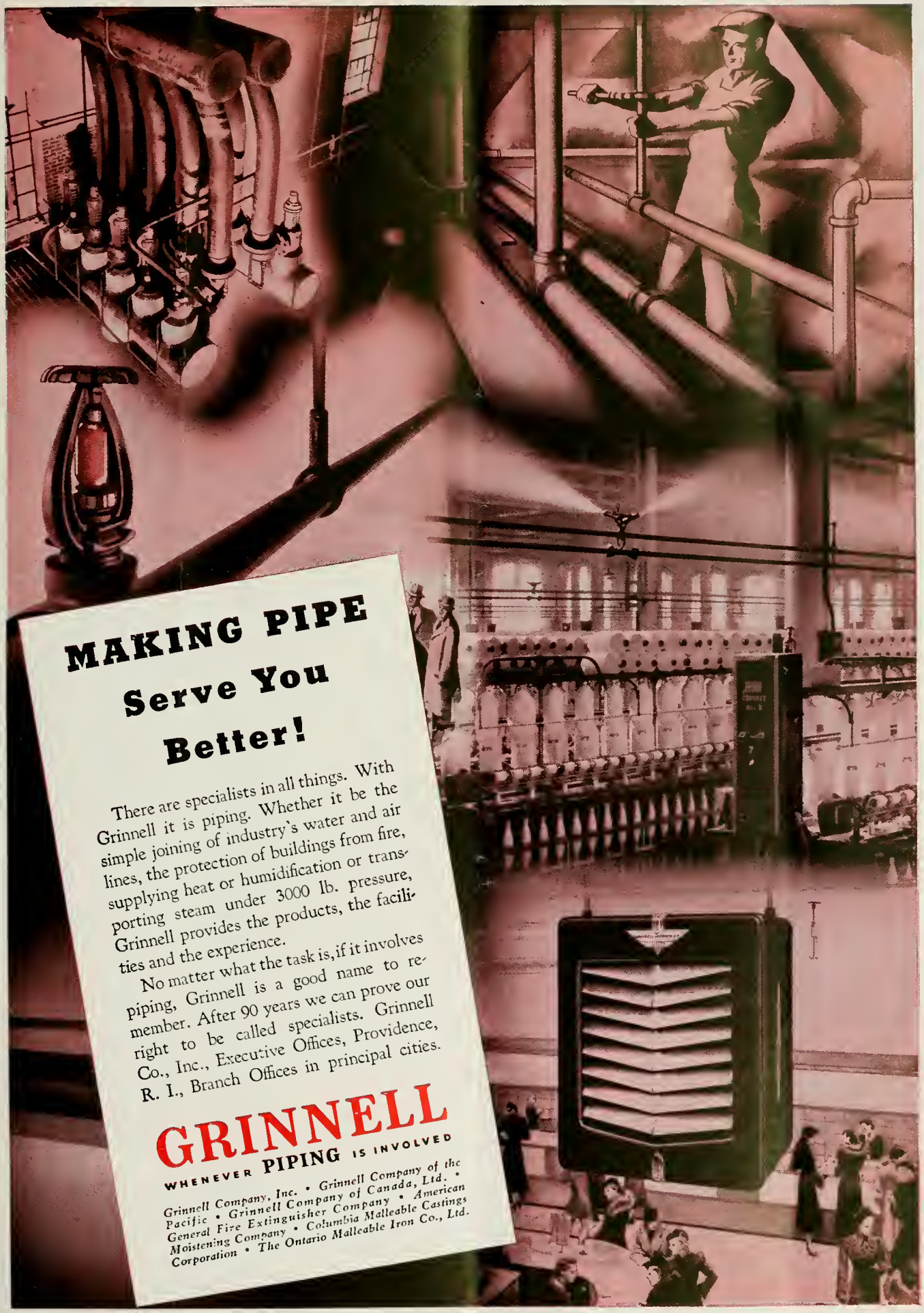
The Schneider-Cruesot Plant of France had loaned Canada technicians. After France fell, these men had to return to their families, probably under threat from the invaders, and thus handicapped Canadian production. The active enlistment drive in Canada is also taking machinists for the air force as pilots and maintenance men.

In spite of these handicaps, Canada expects to reach her peak production on schedule, February, 1942. At this time, total production of automatic guns will reach 147,500 units per annum. A newly authorized modern army rifle, authorized last August, will shortly reach production of "thousands per month." Information is lacking on the heavier gun production, but the program to date has met or bettered every delivery promised.

Artillery production is an intermediate between extraordinarily high grade jobbing work and precision mass manufacture. Quantities may run into a matter of thousands per year; ample to justify repetition methods. The time element requires means whereby unskilled hands can be enabled to produce in quantity.

Design of components is solely for correct functioning. Modifications for more efficient and cheaper manufacture are often impossible or difficult to arrange in such a short time. Time also does not permit the development of specialized tools such as in the automotive industry. Therefore, standard machine tools rather than production units bear the brunt of production. Hand finishing also adds to

(Please see page 22)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Above: U. S. Engineers' methods are widely copied.

★

CANADA'S DEFENSE

. . . *from Page 20*

the time and cost of these precision products. 16,000 man-hours is the actual time consumed to produce the intricate twin gun mountings for naval guns.

Of interest to engineers is the rifling process where, in accordance with latest developments, 21 separate broaching cutters, of successively increasing sizes are integrally mounted and pushed through the drilled barrel simultaneously to complete the job in one operation. Each cutter takes a cut of .015 meter. This screw powered broaching machine carries the broaching spindle forward while the circular broach is simultaneously rotated by a helical groove running over fixed keys in the stationary head.

Of interest to T. A. M. 3 and 63 students is the process called 'Auto-frettage,' used in barrel production. This is a method for automatically producing internal compressive stresses in the bore, formerly achieved by winding layers of steel wire under high tension about the barrel. The object is to have the bore under compressive stress when the initial bore pressure is zero. Thus the explosion pressure must overcome the original compressive stress before the steel is strssed in tension.

This initial compressive stress is conveniently done by fluid at high pressure expanding the cylinder at room temperature until almost all the metal has been stressed beyond its elastic limit. The metal at the bore, being stressed the most, attempts to maintain its permanent set after yielding plastically. The outer layers, having only been stressed within their elastic range, attempt to return within their original dimensions, compressing the inner layers. The fluid is glycerine and water, for water alone under such pressures at room temperature would freeze.

Think, men, T.A.M. may win this war!

Speaking of Detroit, it has been declared the healthiest city in the U. S. Evidently, dodging automobiles is a healthful exercise.

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The ramparts we build...

As OUR COUNTRY moves through perilous world events, national defense is uppermost in our minds. Is defense production fast enough? Is American industry turning out the goods? How are American engineers and production men meeting defense problems?

Here's how matters stand at Westinghouse:

We are engaged in building more than $300,000,000 worth of equipment for the national defense program. On our books are more than 3,600 defense orders. To meet schedules, we must produce $960,000 worth of apparatus every day—$40,000 every hour—between now and the end of 1941.

Every one of the Company's 26 manufacturing divisions is working on national defense projects; most of them on a three-shift basis.

Employment is at an all-time peak of 75,000, a gain of more than 25,000 since a year ago. One in three Westinghouse employees is new.

To avoid delays due to shortages in materials and to release metals needed for other defense projects, substitute materials committees have been organized in every Westinghouse plant to find ways to make use of new materials wherever possible. One result: our Merchandising Division alone has found ways to save 1,500,000 pounds of aluminum out of next year's manufacturing schedule. That's enough to build 130 Army bombers.

Many things we are making for the Navy, Army, and defense industries are military secrets, but we can mention:

Parts for control units on anti-aircraft guns.

Special land, sea, and air radio equipment for the Army and Navy.

High-speed X-ray equipment, capable of examining soldiers at the rate of one a minute.

Army binoculars.

Fluorescent lamps for "blackout" plants and others.

Secondary networks for defense plants. These are systems of power circuits and equipment so arranged that if one part of the factory is destroyed, current will continue to be available in all undamaged sections.

Some of the things we're making for air defense are:

Special meters and instruments for Army airplanes.

Lightweight generators and voltage regulators to supply and control electric power in Army planes.

Bomb fuses, now being turned out at a high rate. Production will be doubled again in a few weeks.

Plastic parts for aircraft, including Micarta pulleys and fair leads to guide the control wires inside planes.

Radio sending and receiving apparatus.

Lighting systems for airports and seadrome lights capable of converting open waterways into landing bases for seaplanes.

Now at work on propulsion equipment for more than 100 Navy ships is the Westinghouse Steam Division plant at South Philadelphia.

Driving gear for 80 merchant vessels also is being made at this plant.

Besides helping to build our first lines of defense Westinghouse is supplying power equipment urgently needed for the speed-up of its own and other defense industries.

Our East Pittsburgh Works this year will *double* its 1940 production of generating equipment.

The Generator Division completed this year the three largest water-wheel generators in the world—108,000 kilovolt-ampere giants for Grand Coulee.

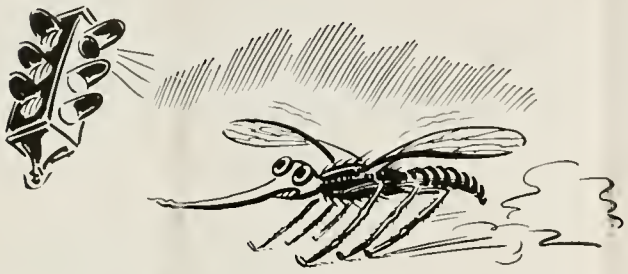
The Motor Division will produce enough motors in 1941 to develop 2,660,000 horsepower; enough power to drive all the machinery in 50 steel mills. Majority of these motors will be driving machinery for defense.

This, in outline, is the way the Westinghouse Company and Westinghouse engineers are doing their share in national defense.

Westinghouse

Westinghouse Electric and Manufacturing Co., Pittsburgh, Pa.

G-E Campus News



MOSQUITOES DON'T LIKE RED LIGHTS

OUT in Cleveland, Ohio, a group of engineers and entomologists has been spending a lot of warm summer evenings sitting around under a string of colored lights. But any passerby who got the impression that they had joined the rocking-chair brigade would be very much mistaken. They were conducting a scientific experiment to determine what color lights attract, and what repel, night-flying insects.

Results: mosquitoes and most other night-flying insects don't like red lights, prefer blue. But since red is not a very satisfactory color to work under, the scientists suggest that if you must work under a lamp outdoors, yellow light provides the maximum advantages to human beings with the minimum attraction to insects.

LEFT-HANDED BUCKETS

UNLIKE the famous fellow who wanted a left-hand monkey wrench, the young man at the window is perfectly in the right if the buckets he wants are the buckets for a steam turbine. For a double-flow turbine for ship propulsion has both right- and left-hand buckets.

There's an important reason for using this construction. Though it sounds more complicated, a double-flow turbine operates at higher speed, weighs less, and occupies less space than a single-flow one. All these are distinct advantages when the equipment has to be installed in a ship, where space is at a premium. And in times like these, when turbines must be turned out in a hurry, the smaller metal parts required represent an advantage in manufacture, too.

General Electric, which has probably built as many naval and marine turbines as any other single manufacturer, is right now making more of them than at any time in its history. And by taking advantage of every engineering and manufacturing advance, it is turning them out on what approaches a mass-production basis.

WANT A BOOKLET?

NOT required reading in any course we ever heard of. But if lightning should strike you some day, you'd be glad to know what hit you. This booklet explains the whys and wherefores of lightning. Tells you how to recognize lightning when you see it, how to catch it if you should want to take some home to play with, etc. In fact about the only thing missing is a "lightning" index to enable you to thumb to your favorite passage in less time than it takes to say "blitz."

And if you have just been on a textbook-buying binge, you may be interested in the fact that this 24-page pamphlet is free.

If you *are* interested, write to the General Electric Company, Dept. 124F, Schenectady, N. Y., and ask for "The Story of Lightning," based on the work of Dr. Karl B. McEachron author of the book, "Playing with Lightning."

GENERAL ELECTRIC

958-28-211

ILLINOIS TECHNOGRAPH

December
1941

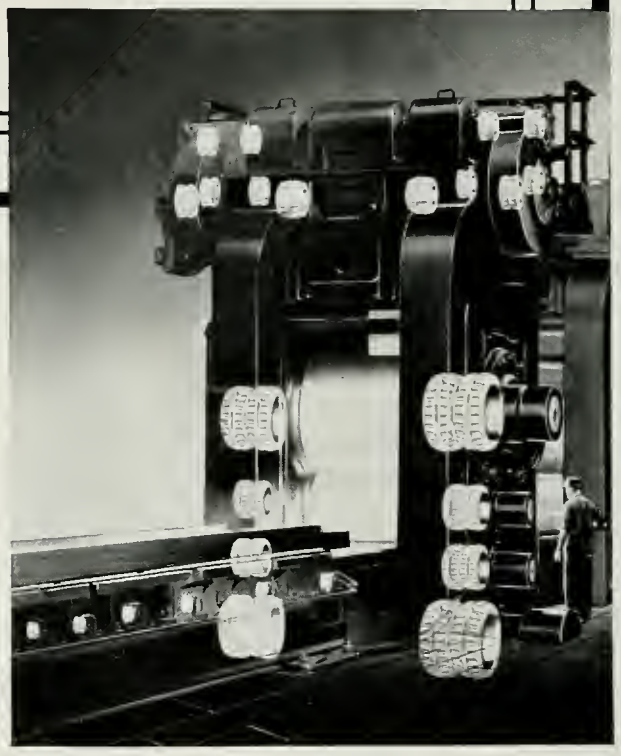
- *Plastics for Christmas*
- *Frequency Modulation*
- *New Cars*
- *Fashions*
- *Names in the News*
- *Technocracked*

Left: Winter on the Campus
"The Boneyard"

hed 1885 Member E.C.M.A.

20¢

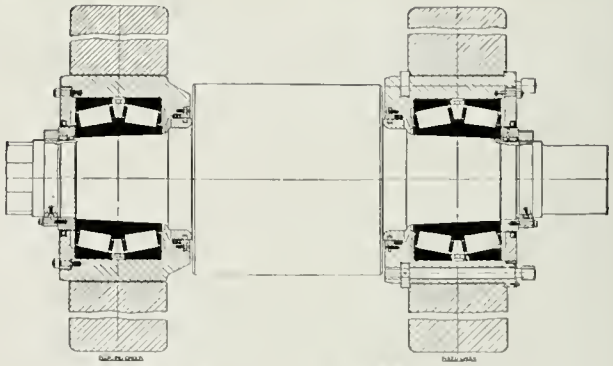
What Bearings would you specify for a Steel Rolling Mill?



Let's assume that you were asked to design a 4-high continuous strip steel rolling mill to operate at a rolling speed of 2,000 feet per minute. What bearings would you select for the necks of the back-up and work rolls?

If you knew your bearings you would specify Timken Roll Neck Bearings. Then you would be sure of smooth mill performance at all speeds; steel rolled true to gauge at all times; simplified lubrication; long bearing life (Timken Roll Neck Bearings hold all records for tonnage rolled); easy roll changing (no delicate parts to handle); fewer involuntary production interruptions.

This is but one of thousands of bearing applications in industrial machinery where Timken Bearings have proved their supremacy. When you have gained a thorough knowledge of Timken Bearings you will be in position to solve any bearing problem you may ever encounter. Write for a copy of the Timken Reference Manual—a valuable text book.



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DECEMBER, 1941

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Published Eight Times Yearly by the Students of the College of Engineering, University of Illinois

Published eight times during the year (October, November, December, January, February, March, April, and May) by The Illini Publishing Company. Entered as second class matter, October 30, 1921, at the post office of Urbana, Illinois. Office 213 Engineering Hall, Urbana, Illinois. Subscriptions, $1.00 per year. Single copy 20 cents.

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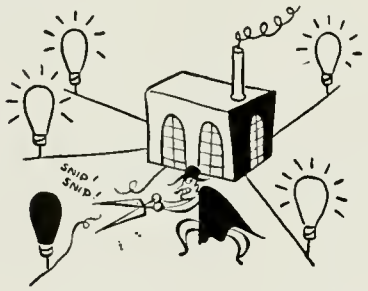
When power must not fail!

How a Westinghouse Distribution System Foils Lightning, Accidents, and Saboteurs

BEHIND America's urgent defense production, stands electric power. It runs the machines that turn out the weapons for the defense of America. It must not fail, must not even falter.

In the first World War, this vital power could be cut off, and cut off easily . . . by saboteurs, by accidents, or by lightning.



▶ For, in those days, the *only* means of distributing electricity was through *radial* systems, in which the power lines radiated like the spokes of a wheel with the power station as the hub. So, if *any part* of a power line were damaged, no electricity could be delivered to users *all along the line.*

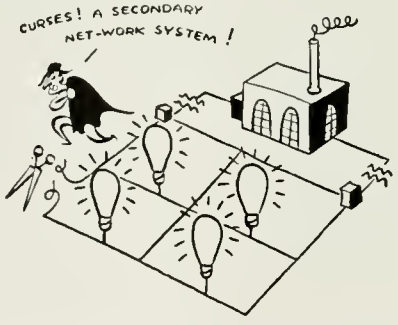
No way was known to reduce the vulnerability of power distribution until the early '20's, when engineers of a large power company conceived the idea of the *secondary network system.*

▶ The idea was to connect low voltage secondary lines in a *network*, with the main power (primary) lines joined to the network at several places. Thus, with power being sent along several different routes, a line could be damaged and electricity would continue to flow to its users along the other routes.

It was a great idea . . . if it could be made to work on large and complicated city systems. That was the problem, a problem which the power company brought to Westinghouse engineers.

▶ The secondary network system wouldn't work at all until some pump-proof method was found to keep power from flowing backwards into a damaged section of the line. Westinghouse engineer John S. Parsons (a member of Georgia Tech's class of '21, a graduate of the Westinghouse Training Course, and the holder of 30 of the 150 patents on secondary networks) found the way . . . a pump-proof relay which, when power is flowing in the wrong direction, closes its contacts and causes a network protector (automatic air circuit breaker) to trip and cut the feeder off the line.

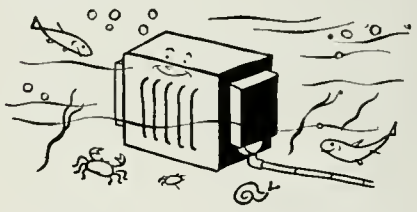
Then, there was the question of where to put the transformers, relays, and protectors that secondary networks needed. The amount of space this equipment would take up would be tremendously expensive in crowded cities.



▶ The obvious way to overcome this obstacle was to put this secondary network equipment underground. But transformers, relays, and protectors wouldn't perform properly in damp underground atmosphere. Westinghouse engineers went to work and developed a transformer-relay-protector unit that could fight off dampness and perform as well underground as above ground! Now, there are network units that do their job even though submerged under salt water, twice a day!

To make doubly sure that they had the space problem licked, Westinghouse engineers cut down the size and stepped up the power capacity of these network units. They made it possible for a unit that was one-third smaller to do the same electrical jobs!

▶ Secondary networks raised all sorts of new problems. And Westinghouse engineers had to find a lot of new answers before they were able to bring secondary networks from an idea to a working distribution system.



Today, Westinghouse engineers have brought secondary network systems to 164 cities. They've adapted these systems to the specialized needs of defense plants, army camps, airports, and power houses. Their work has contributed tremendously to today's ability to distribute unfailing electric power . . . despite lightning, accidents, and sabotage.

★ ★ ★

▶ This story illustrates how Westinghouse engineers work. More than that, it shows how the Westinghouse Company works. For there are 1,500 engineers in Westinghouse . . . in service, in management, in design, in sales, in every single branch of the business. These engineers give the company its point of view.

Westinghouse takes pride in the engineering behind its products. Its engineers are always analyzing its products, working over them, making them better. It has the engineer's impatience with the old and his eagerness to create the new.

▶ Engineers founded and built Westinghouse. Engineers will carry it on.

Westinghouse

Westinghouse Electric and Manufacturing Co., Pittsburgh, Pa.

SANTA WILL COME

Editorial By Donald K. Stevens

Christmas is coming in a different way to countless homes this year, different from last year and perhaps different from next year too. Militarism is all mixed-up in the air with winter's usual cold winds and crisp snow. We may well expect Junior's toys to be soldiers and Susan's dolls to be nurses when Santa opens his bulging gift sack this Christmas eve. "Peace on Earth" seems far away.

My friends are in the army and in the air corps this Christmas. I expect to be called myself when I graduate next June, but I'm not kicking. From the R.O.T.C. one learns to take orders as well as give them. If the scrap gets worse "across the pond" we'll probably go into it. Personally I don't believe in this war, 'though you may or may not agree with me. If for defense, I will fight. It really doesn't matter in this case; you and I may both get a chance at stopping bullets, and soon, too.

With an engineering education, I had presumed someday I'd make glass or brick, that you'd build bridges or wire motors. I'm an optimist—I think I'll yet do those things if I can get a job after the army. If you have the same luck you'll be doing your bit of engineering too. And if we do get in it, and if we shouldn't get back—we might have done much worse than "advancing brilliantly" or "retreating strategically."

It's the Cause for which we'll be fighting—not the mud, the blood, the glory. It's a ramification of the same thing for which we are every day engineering—for life, for homes, for men, women, and children. And if we, the engineering students of this country, do our designing and building well during the next few "critical" years, we'll be building a nation that will withstand the "fatigue stresses" of normal years. And Santa will be able to come next year.

FROM A READER . . .

1000 W. Illinois St.,
Urbana, Illinois

Dear Sir:

In reading through your publication I was surprised to see only one technical matter discussed. Why don't you request your readers to submit questions on modern engineering subjects, then acquire professional information from authoritative sources and reprint for the engineer's general information?

Personally I would like to know more about fluid drive in pleasure automobiles of today. If you have published facts on this material in past issues I would appreciate information concerning this subject.

Al Neely, EE '43

Note: Al will find Bob McCleary's article on the '42 models of interest. More of this type of information is to follow in subsequent issues. We appreciate all readers' comments and will publish those which are properly signed. —Ed.

They say a hug is energy gone to waist.

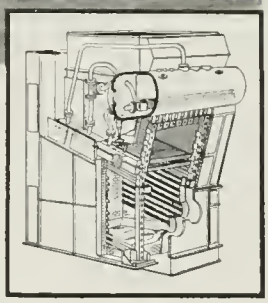
"Was Jane in a red frock at the dance?"
"Some of her, Bill, some of her."

When a girl finds that she is not the only pebble on the beach she becomes a little boulder.

POWER FOR DEFENSE

On a ship of the U. S. Navy in 1932, Babcock & Wilcox, the nation's oldest and largest manufacturer of steam boilers, first proved the safety and practicability of welding high-pressure boilers. This advance eliminated the former riveted boiler and led the way to higher pressures and efficiencies everywhere—more power at less cost.

Today, even while B&W is working on an unprecedented volume of defense orders for steam generating equipment, the Company's physical, metallurgical and chemical laboratories are energetically evolving new developments. Thus, because of B&W leadership, a ton of coal, a barrel of oil, a cubic foot of gas, or even a cord of wood, produces still more power for defense and for industry as a whole.



B&W Single-Pass Marine Boiler as used in modern merchant vessels.

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". . . Ring Out the Old, Ring in the New"

LAW BUILDING CHIME TOWER

Plastics *for* Christmas

REPLACE GIFTS ELIMINATED BY PRIORITIES

If you are helping Santa Claus, and are afraid National Defense has beaten you to the counter, take these ideas shopping with you.

By Hayward F. Talley
Freshman in Electrical Engineering

A hope for filled stockings and a joy in giving are among the emotions which have marked the approach of Christmas in American homes through the years. As a result, our industry has become accustomed to diverting large quantities of raw materials to the production of hundreds of attractive articles, practical and useless alike, which may be used as gifts for presentation on Christmas.

This year it is a recognized impossibility to divert most of the usual products to the manufacture of Christmas gifts, and factories which have manufactured such gifts in the past are now busily engaged in the fulfillment of contracts for defense products. After considering these facts, retailers from coast to coast began to squirm and nervously question industry, "Is the American public to be disappointed this Christmas?"

And Industry has replied: "No!" "Christmas, 1941, will carry with it the same ideals of giving, the usual glittering counters, and window displays which may even surpass the brilliance and splendor of those of a year ago. The reason is the formation of a new industry which is rapidly making its way into the foreground of business enterprise. That industry may be called the production of "Synthetic Plastics."

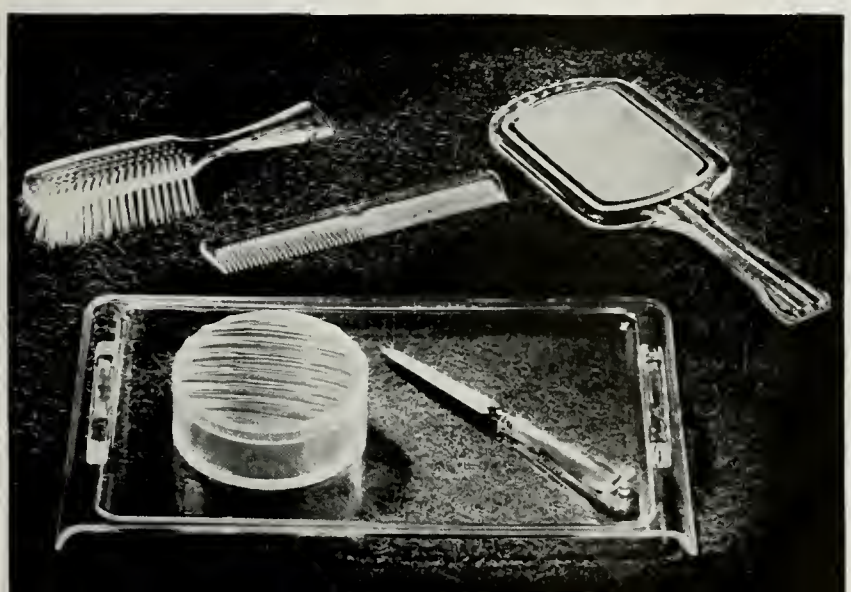
The story of synthetic plastics is now making its premier debut in the theater of a modern and changing world. This new wonder emerged from the chemist's test tube in a flashing display of color, beauty of pattern, and brilliance. It opens to the layman an opportunity to decorate his home in a manner denied even to "Solomon in all his glory."

Shortly there will be found on the counters of our stores everywhere magnificent manifestations of the approach of the Yuletide season; articles which possess the sheer beauty of jade, the cloudiness of natural onyx, the transparency of crystal, the jet black of ebony, and the lustre of amber. Such articles were once possessed only by the privileged few; now they may be owned by anyone. These gifts will not sell merely because they imitate the more expensive materials; they possess a beauty in their own right.

(Please See Page 18)

Illustrations below and to the right demonstrate the wide use of plastics in the manufacture of universally used products. Applications range from the manufacture of Christmas ornaments (lower right) and dresser sets (below) to radio cabinets and covers (right).

—Cuts Courtesy Modern Plastics



No More Static

and Many More Radios Using Frequency Modulation

•

By Hayward F. Talley
Freshman in Electrical Engineering

Something new and vital has come to radio. Those who have not followed the progress of Frequency Modulation are today amazed at the announcements which are being made. We are told that 15 commercial and 15 experimental FM stations are now on the air. Permits for more than 40 additional transmitters have been granted; among this number is a permit for the construction of FM station WIUC at our own University of Illinois. It almost seems that this new wonder of radio has risen up full grown over night, but as we turn back the pages of history we see this is not true.

The history of FM had its beginning with Major E. H. Armstrong, protege of Michael Puppin, Columbia University's famous Professor of Electrical Engineering. For three years, until entering the service of his country in the U. S. Signal Corps in the first World War, Armstrong struggled with the problem of static elimination without success. During the war as a member of the Signal Corps, he invented the "Superhet" principle upon which most present day receivers are based. Following the war, Armstrong patented the "super-regenerative" radio circuit and numerous other inventions.

Below: WOR's FM transmitter

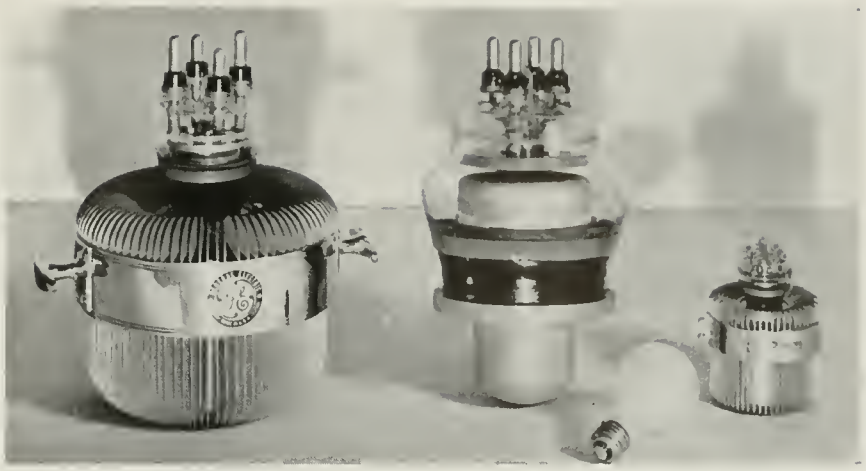
Above: J. R. Poppele, WOR's Chief Engineer, and Conductor Alfred Wallenstein examine FM speech input equipment.

In 1924 Armstrong retackled the problem of static elimination. Little more was heard of Armstrong until 1939, when he not only gained success in static elimination, but also in the development of an entirely new system of transmission and reception which incorporated many new, highly desirable qualities far removed from the elimination of static. This new development was termed "Wide Band Frequency Modulation"; thus FM began its journey along the world-wide pathways of radio.

Many insisted, as did Fortune Magazine, October, 1939, that 40,000,000 home receivers and 800 transmitters became obsolete the day the FM system was perfected. Engineers within the industry were more conservative. They realized that possibly years would be needed to change two million dollars worth of equipment to another system, no matter how superior that system might be.

Two years has elapsed since FM made its formal debut into an expectant world. Today we are witnessing the enthusiasm, wonder, confusion, and excitement which was predicted to accompany FM two years earlier. Amid this changing radio era, it is only natural to wonder just what Frequency Modulation is—how it is different from the present radio system.

From the standpoint of the average radio listener, there are two major differences between our present radio system and FM. First, Frequency Modulation has an amazing, characteristic fidelity found in no other known method of radio communication. This means that music and speech will be broadcast and reproduced realistically so that the program will sound natural to the human ear. FM systems give the truest duplication of studio programs known to radio. The management of a recently constructed midwestern FM station carried out an experiment which proved that it is impossible for the human ear to distinguish between a program actually presented in a room and the identical program presented by means of an FM receiver.



Right: High-frequency transmitting tubes. Notice size of 75 watt lamp.

Cuts Courtesy of Communications Magazine.

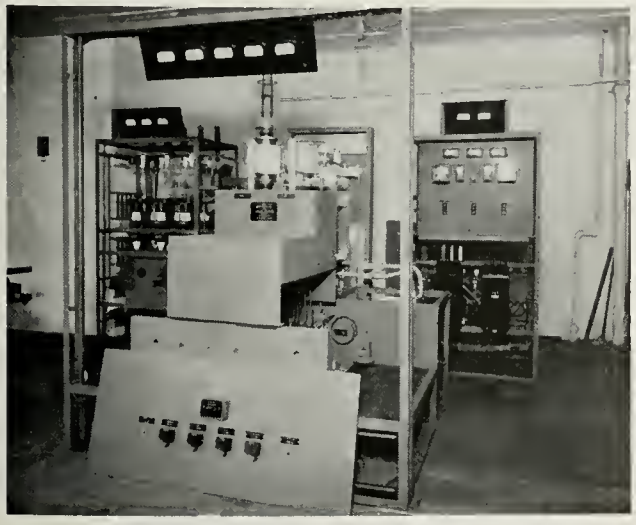
The second major difference between present radio systems and FM systems is the freedom from atmospheric disturbance and local noise which the public groups together under the common term, "static." No longer will electrical storms render a favorite program submerged in undesirable and irritating noise. Neither will it be necessary to use an interference eliminator or noise filter to prevent the "noise" from a vacuum cleaner or electric shaver from reaching the receiver. FM has crushed static, the pet-peeve of the radio fan.

The technical differences between our present radio system and Frequency Modulation may be grouped into two sections; namely, (1) Construction, and (2) Performance.

Differences in theory and construction may be determined in a general sense by a comparison of the names of both radio communication methods. The usual radio system may be called, for purposes of comparison, Amplitude Modulation. AM is the process by which the amplitude (i. e., the maximum value of wave movement on either side of its zero point) of a carrier wave is varied in accordance with a signal wave. Frequency Modulation, as its name implies, is the process by which the frequency of a carrier wave is varied in accordance with a signal wave.

Technical differences between the performance of FM and AM are many and varied. A person will be heard with the same volume when standing at six feet from an FM microphone as he would be standing a distance of six inches from an AM microphone. A noise which would not be picked up by the most sensative "mike" on an AM system would be picked up without difficulty by a "mike" on an FM system. Thus FM changes the duties of the sound-effects man. On the usual AM system, it is many times necessary to produce very radical sound effects in the studio in order that the sound will sound like the "real thing" when reproduced by the receiver. With an FM system, you may always be sure that a sound is reproduced exactly as produced before the microphone.

Below: 50-kw frequency-modulation transmitter under construction



While the height of the transmission antenna of an AM system has only a limited effect on the effectiveness of the station, it has a great deal to do with the effectiveness of an FM station. It is imperative that the FM "irridiator" be installed at as high a point as is practically possible.

Stations on our present AM systems are located at intervals far smaller than are FM stations. This means that if all other conditions were equal, a given portion of the radio band would carry far more AM stations than it would FM stations. However, a number of FM transmitters may be assigned to the same frequency, provided they are several hundred miles apart. There is no cross-modulation of interference. This is due to the fact that the FM receiver will reproduce only the stronger of two signals, suppressing the weaker one (provided the ratio of the signal voltage is 2 to 1 or more.) When the weaker signal is desired, it could be picked up by means of a directive antenna which would make it possible to increase the signal voltage of the weaker station. In view of these facts, we see that a chain of FM stations covering many square miles could be located on one point of the FM band.

If we would consider another fact, we would have little fear of a few FM stations filling the entire radio band. With the invention of Frequency Modulation, the scientists of the world have begun to probe the mysteries of that vast new region of the radio frequency spectrum known as the ultra short waves. These are waves from about 10 meters in length to waves of less than 1 centimeter in length. That portion of this new spectrum provides *nine times* as much space as is now occupied by all existing radio services, regardless of the wave-lengths they use! Between 1 meter and 1 decimeter, 90 times as much space is provided and between 1 decimeter and 1 centimeter, this space is 900 times as great! Thus between wave lengths of 10 meters and 1 centimeter we find nearly 1,000 times more space in the frequency spectrum than is occupied by all radio services in existence today.

Frequency Modulation is the boon of the radio fan. Not only does it fulfill hopes for improved police communication, for news picture transmission, and for Army and Naval communications, but it becomes the foundation of new hopes for ultra short waves, and the cause of an era in the history of radio in which performance is the primary factor of consideration.

1942 MODELS

are 'Definitely Different'

By Robert E. McCleary
Junior in Mechanical Engineering

Self-styled automotive editor reviews new car trends . . . Opinions voiced are purely those of the writer and admittedly biased.

For those engineers who graduate in '42, there is an alluring array of fine cars from which to choose for business or pleasure. The phenomenal improvement of automobiles from year to year leaves a bright ray of hope, however, for those engineers who don't graduate in '42. . . . Just think of the beautiful jobs the industry will be featuring when the class of '45 graduates!

Yes, 1942 models, all rumors to the contrary, are definitely different, primarily in styling. Engineering readers realize that the usual yearly change is one of jacking up the grill and front fenders and running in the previous model under the newly designed front end covering. However, over a period of years, definite developments in chassis, transmissions, motors, and accessories take place.

From an objective view point, the following trends in the past few years, are quite obvious and continue unabated this year.

Bodies are wider and lower, with more elaborate streamlining. Fenders tend to hide the wheels; this year they take on the appearance of a battleship torpedo-bulge and extend back into the doors, sometimes clear back to the rear fenders as in the Buick 50 and 70 series. Unit body-chassis design as in Lincoln Zephyr and Nash is gaining ground. Better vision with larger windows, concealed running boards, rotary door locks, the elimination of driveshaft hump in floors, Smoothly sloping rear decks and large luggage compartments are universal tendencies.

Motors seem to be getting larger although many firms are "squeezing" more power out of the same sized engines by restyled combustion chambers, better carburetion, higher compression ratios, and redesigned valve mechanisms.

Wheel suspension has been undergoing the greatest changes. The trend is toward coil springs on all four wheels as in Olds, Buick, and Nash. Coil springs are durable, noiseless and frictionless. Tonsorial stabilizers (sway elminators (sway eliminators) are almost universally used. Telescoping, airplane-type shock absorbers are replacing all others. Member pairing is tending toward use of synthetic rubber joints under compression.

The small Nash features a novel front wheel suspension of the type previously used in expensive European cars, i. e., springs set around a fixed vertical shaft on which the king-pin assembly slides as road irregularities are absorbed. The writer chooses to call this the 'pogo stick principle' of suspension, and believes it should prove very satisfactory. In fact any deviation from convention in design is hereby regarded as a healthy sign, and is helping to dispel the writer's belief that the industry is hidebound by tradition, and may yet produce his 'ideally engineered car.'

For '42

Consumers want to know if new cars are up to last year's standards despite replacement of priority materials. The author discusses features of the new models.

Steering ratios are remaining high. The trend is toward centerpoint steering, for shock proofing reasons, and larger steering wheels. Transmissions are definitely tending toward the automatic. Clutches are being replaced by the phenomenal new fluid drive, and from there on the transmissions may be conventional, semi-automatic, or entirely automatic.

The Hudson Drive Master, a combination of the automatic and semi-automatic type, offers 3 automatic speeds forward including overdrive. The clutch is vacuum controlled. Manual control is possible by a button.

The Studebaker Turbo-Matic Drive consists of a fluid coupling, a vacuum-operated clutch, a conventional 3 speed transmission, and a kick-down overdrive. This is of the semi-automatic type, although continuous operation is possible outside of heavy traffic and steep grades. There is no clutch pedal. The Lincoln and Mercury Liquomatic Drive is essentially the same as the Studebaker shifter in that shifts from second to high to overdrive are automatic. The main components of the mechanism are those of the Studebakers.

Dodge All-fluid Drive is merely a fluid coupling in addition to the ordinary clutch. This permits continuous operation for two speeds, high and overdrive. All other shifting is done as usual. DeSoto Simplimatic and Chrysler Vacumatic transmissions are similar to the Dodge Drive. Manual clutching is necessary for shifts from low to high range. Fluid coupling eliminates clutching on starts as in the Dodge.

Packard Electromatic Drive is a standard transmission with kickdown overdrive but with an automatic electric-solenoid operated clutch which eliminates pedal action.

The Oldsmobile-Cadillac Hydramatic Drive most closely approximates the ideal automatic transmission. There is no clutch pedal. A steering column lever offers Hi, Lo, neutral, and reverse. In Hi, four speeds are automatically available, the car always starting in low. Lo is seldom, if ever, used except in trailer pulling or for slow down-grade descent. Kick-down effect from fourth by accelerator depression is incorporated. Elements of this automatic transmission include a fluid coupling, and a complex oil pressure operated system of bands and clutches about planetary gearing as first used in model "T" Fords.

Tires are larger in cross sectional diameter this year, the 15 inch rim making its appearance on many of the new cars.

Defense priorities necessitated a switch from aluminum alloy to steel or cast iron pistons and cylinder heads in general. Chrome trimming has been replaced in many instances by stainless steel whose lustre may be occasionally revived by rubbing with a lemon juice soaked cloth, presumably removing the oxide by citric acid action.

For body beauty, the writer nominates the Cadillac 61 convertible coupe, and the Buick 50 and 70 Sedanet, along with the beautiful Packard Clipper Series. Packard has finally abandoned the "status quo" styling of tradition and produced a breath-taking sensation.

In the medium priced field, the Olds 60 Series Club Sedan and DeSoto con-

(Please See Page 13)

Plowing in a 1600 mile telephone furrow *for defense*

To assure coast-to-coast telephone facilities adequate to meet future defense needs of the nation, the Bell System is constructing a 1600 mile, $20,000,000 cable line between Omaha and Sacramento.

Several newly developed "plow trains," working from opposite ends of the line, are burying the cable for maximum protection. They dig deep furrows, lay two cables in them and cover them with earth — all in one continuous operation. Their meeting will mark completion of the first *all cable* line across the continent. Carrier systems will be operated in the cables —one direction of transmission in each.

This vast project is just one of thousands in which the Bell System is now engaged to provide additional communication facilities so vital to Army, Navy and defense industries.

AMERICAN TELEPHONE & TELEGRAPH CO. AND ASSOCIATED COMPANIES — BELL SYSTEM

NAMES

. . . *in the news*

By William R. Schmitz

Freshman in Chemical Engineering

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JOHN ADKINS

Cadet Lieutenant Colonel John Adkins is very interested in the military side of life here at the University of Illinois. John is a first lieutenant in both Pershing Rifles and Scabbard and Blade. He also is president of Pi Tau Pi Sigma, military fraternity of the Signal Corps. He belongs to A. I. E. E., and is on the military council.

John comes from Ashland, Ill., where he starred in basketball for the high school team. He fortunately won a scholarship to the University, and thus followed a brother and two sisters to the University.

To underclassmen, John advises not to strive too much for good grades. Get the practical, rather than the theoretical side. He believes that activities are almost as important as grades. Electronics and radio are his own favorite subjects.

John has as his hobbies radio, and to a certain extent, photography. Thus he keeps his hobbies right in line with the Signal Corps and communication. There is no doubt that military is John's first love. He says that military is a little tough sometimes, but that he really enjoys it. Expecting to be called into active service as soon as he graduates, John thinks that things look sort of bad now in the world situation. But he says that the army is doing very well so far in their training.

One other thing claims a large portion of John's life and time,—the inevitable girls. John thinks that there are some "awful nice" ones here on the campus. His roommate says that he is really smooth with them; that he "sure hooks them." No wonder Johnny Adkins likes Champaign-Urbana and the "Pretty" campus.

RAY CARLEN

Ray Carlen is a metallurgical engineer. He is president of the Mineral Industries Society, member of Skull and Crescent, and a member of Alpha Sigma Mu, scholastic honorary fraternity. Ray is also a Lieutenant Colonel of the Engineers, belongs to Pershing Rifles, and is on the military council.

Ray lists sports of all kinds as his hobby. He is particularly interested in billiards, bowling, and golf, but he does not neglect any one of the other sports. He once won a cup playing billiards.

Ray advises a freshman never to get behind in his work in class, but not to study too hard. The best way is to get a good study habit the freshman year and then you won't have much trouble. And Ray knows what he is talking about, too, since he has a 4.1 average.

This fair-haired metallurgist also likes military and would like to go on to West Point if possible. However, since he is so active in the R.O.T.C., he expects to be called to active service as soon as he graduates this spring. He thinks he may stay in the army for good. He opines that military gives a person many things that civilian life can't. It does a person a lot of good to be under military discipline.

Girls are a source of great pleasure to him. He apparently finds all the dates that he wants without any trouble. Ray delights to take in the social events. He also advises everyone to have a few dates now and then. "It sort of relieves the mind and you are able to do better in your school work then."

Carlen stays at the Skull House and hails from Rockford, Ill. His favorite subjects are mathematics and metallurgy. He thinks that metallurgical engineering has the best school and head of department in the university. When asked what improvements should be made, he said that he was for all appropriations for the engineering school,—the more on the practical side the better.

Ray left us with this last reminder. "Engineering students are superior to all other students, and you will always find them at the top." We think that is a good plug!

EVERETT GREGORY

Everett Gregory is president of the student branch of the American Society of Agricultural Engineers. He is also on the agriculture and the engineering councils. In the advanced military corps, he holds the rank of Second Lieutenant in the Engineers.

Quizzed about the fairer sex, Everett thinks the co-eds here are "pretty good." He wouldn't come out and say so, but he left the impression that he gets around pretty well with the girls. Everett likes to take in as many social events as possible, but the fact that he has to work his way through school takes a lot of his time. He especially likes the coke dates and dances that are held in the Union Building on Wednesday and Friday afternoons.

This native son of Aurora, Illinois, claims a particular interest in motors, especially of automobiles and motorcycles. He also likes to ice skate and to bowl.

Most interested in the Agricultural Engineering Society, Everett works hard to keep this organization rolling smoothly. Everett says that he would rather have more publicity for the club than for himself.

One thing that Everett seemed to stress in our interview was that people didn't seem to know much about agricultural engineering. The development of agricultural engineering has been fairly recent. The agricultural engineering course is divided into two parts. One deals with drainage and the lay-out of the farm, and this course contains quite a bit of civil engineering. The other part deals mostly with power and farm machinery, and this course contains a lot of mechanical engineering. The latter course is the one in which Everett is specializing. We can't blame him for wanting people to know what an Agricultural Engineer does!

NEIL RANDALL

Civil engineer Neil Randall is one of the most successful scholars in engineering. He has the very excellent scholastic average of 4.996. After nearly fainting when he announced his average, we asked him for his formula for making such good grades. "Well," he said, "get off to a fast start at the beginning and work real hard for the first few weeks. Near the end of the semester put on a sprint and make the Prof. think that you are getting all you can out of the course. And then in between put in a lot of hard work." We agreed that surely that must be the formula for success.

Neil is president of Tau Beta Pi, all-engineering honorary society. Member of T.N.T., A.S.C.E., Phi Eta Sigma, and is Captain in the Engineers advanced corps.

On Neil's hobby list are the following: photography, whittling, badminton, swimming, and baseball. He says that he likes to attend athletic contests as well as participate in them.

Optimistically, Neil comments the girls are a "perma-

nent institution" and are here to stay. He thinks that there are some very nice ones around the campus. The greatest difficulty he encounters is to find time to take in all the social events. Then, of course, he laments that his five point average "kind of scares all the girls away."

Neil is really enthused about civil engineering. His favorite subject is structural engineering. He is writing a thesis on the use of tubular members for roof truses. Incidentally, Neil's father is also a civil engineer.

His main ambition is to build bridges. And the recent inspection trip of all the seniors only increased Neil's interest in civil engineering. He saw some things that he "never knew could be done."

Young Mr. Randall thinks that our campus needs some kind of scenic spot, like a lake. (Crystal Lake please note.—Ed.) The university could also stand a new engineering hall. However, he concludes, the equipment is very good, and our experiment station is one of the best.

HOWARD SCHMIDT

Howard Schmidt is one of the busiest men on the campus. He is Captain in Scabbard and Blade, Captain in Pershing Rifles, Lieutenant Colonel of Field Artillery, Captain of Horse Battery, and Plateau and Drum, member of Blue Pencil, senior activity honorary society, A.S.M.E., and is on the military council. He also belonged to Dolphin, freshman-varsity swim team, Caisson club, and is a member of the Freshman-Varsity rifle team. He was chosen the best drilled field artillery man in his freshman, sophomore, and junior years, being given two Connor Cups and the American Legion medal. Co-champion of the handball doubles, he has won several trophies in handball.

Military is one of his great loves. He devotes a great deal of his time to working on his activities. All of these activities do not leave him much time for dates with girls. He says that he has to spend a lot of time on his studies, and then when he does have some time, he has to work in some organization.

Howie first got a look at Illinois as a delegate from his high school to a press conference. From then on he knew he wanted to come down here to the University. So, after visiting several of the Big Ten schools, Howie emphasizes that he likes Illinois better than any of the others. Greatest needs here, he believes, are a field house and more school spirit.

Although he has had to work all his way through school, the hardest job for Howard is to find some medium whereby he can do justice to all his activities and also to his school work. He thinks that most employers care more for the grades than they do for the activities, but he believes that extra-curricular activities will help him a lot in his later life. They help to round out a fellow's life. For example, the fact that he is a Cadet Lieutenant Colonel won't give him any advantage in rank in the regular army, but it does give him a lot of good practice in leadership.

Although Howard greatly likes military, he doesn't want to be a regular army man. He intends to be a mechanical engineer, and not an army officer. His favorite subjects are air-conditioning and refrigeration. He also adds that he would like to be associated with some large engineering firm and hold a responsible position.

AL BOYSEN

Tall, lanky Al Boysen is a familiar figure around the engineering campus. He is a member of Sigma Phi Delta, Tau Beta Pi, Sigma Tau, Pi Mu Epsilon, and Physics Club.

Al thinks engineers are fine fellows, hence he stays at a place where only engineers live. He doesn't advise freshmen to specialize too much. "Get a good general education and then you will be equipped to work in different fields."

Girls don't particularly interest Al, who claims he is pretty shy when around them. He does admit that the freshmen girls are better than usual this year. There's still hope! A very nifty 4.85 average gives impetus to Al's ambition to own a consulting research laboratory. "Then I could go in there and just be able to do anything I wanted." Rhetoric and German alone bothered him scholastically. The rest were quite agreeable.

Rifle marksmanship, hunting, swimming, "chemistry, and electrical engineering" are his hobbies. Many people wonder about the latter two, but Al says they are really not work to him.

When asked about the world affairs, he replied, "It's an awful mess." He doesn't think too much of the way that the country is being conducted, and hopes that the European nations wear themselves out so that they can't lift a finger. Al is registered under the Selective Service Act, and thinks that he will more than likely be called as soon as school is out. He doesn't relish going into the army and would like to stay out. What would his home town of Elmhurst, Illinois, do if he were drafted? . . . They'd need another "local boy makes good" to match him.

1942 MODELS *are 'Definitely Different'*

. . . *from Page 10*

vertible coupe get the vote. It is interesting to note that the doors which conceal DeSoto headlights in daytime and give smooth front and appearance, were first used on the 1935 Cord.

The Chevrolet Aerosedan and Sportsmaster four-door sedan take the honors in the low price field.

Ford, Mercury, and Hudson, are way out of the running, in my opinion, concerning style. All Fords and Mercurys look as if they came off an assembly line. They are poorly proportioned, stubby, too high, and box like. The height is due to Ford failure to adopt a hypoid rear end (the only make of full sized cars so designed outside of Hudson) which permits overall lowering of the body as much as 3 inches without a floor tunnnel.

Hudsons are superfluously broad and look as if the maker spread a lot of metal too thin in order to give the impression of massiveness. Hudson windshields are too shallow for symetry and grillwork gives a frowning appearance to the front end.

As regards the Crosley, Bantam, and Willys, let it here be predicted that the American people will never forsake long, sleek hoods, heavy car riding qualities, and high-powered acceleration for the economy of these fly-weights.

Not much is to be desired as far as mechanical perfection is concerned on these new cars of today, including those less beautiful. The writer believes, however, that certain fundamental changes in wheel suspension, modes of power transmission and point of power application, economical motor design, and passenger comfort have been pigeon-holed or overlooked because of fear of introducing something "too novel for sales benefits."

(Watch your Technograph for something about "air cushioned" suspension and "stressed rubber" springing, simpler automatic transmissions, front wheel drives, super-charged two and four cycle engines, and steering wheel positioning.)

The Fashions

. . . as Illini Interpret Them

By 'Beau Brummel' Murphy, C.E. '43

Because of a recent exposure to military life where everything was uniformal, your writer turned inquiring reporter in order to determine what the well dressed engineer wears. The times have changed since the early thirties when all you needed to be an engineer was a sweat shirt and a slide rule. The sweat shirt hasn't entirely disappeared, and the slide rule is here to stay (you can quote me on that.)

One LAS who rooms with an engineer tells me that he knows from experience that engineers usually wear their roommate's clothing. Another inquiy yields the suggestion that if canoes aren't already carried they would make very beautiful accessories.

Most of the colorful dressing is done by the freshmen and sophomores who are corrupted by contact with the LAS college, but the C. E. junior who spends one day wading in concrete and the next in bitumen wears the oldest clothes that he can find. The M. E. and the Met. E. are handicapped when it comes to being a "Joe College" because of their lab courses.

Comfort seems to be the key word to the engineer in his dress and this includes the work clothes that are worn in the labs. Sweaters are the most popular item, next

'Sweaters are the most popular . . . "

to trousers, in the apparel of the engineer. I am assuming that those who come from Arkansas are civilized enough to put on shoes. All models and all methods of wearing a sweater can be seen on the campus. Some prefer the crew neck without any shirt while others religiously wear a shirt; some like their sweaters heavier than others; but nearly all of the students forego the tie. I can support on the little finger of my left hand all the ties in one class. The sleeveless sweater is becoming more and more popular.

The most noticeable trend is in the sudden advent of the Western styles even to the extent of high heeled boots. Bright colored shirts and blue denim trousers can be seen very frequently on the campus north of Green. The number who find it advisable and comfortable to come to class in true Harvard style is small compared to the other colleges; however, there are a few of those radicals around and they will be ignored by this artcle.

When asked what they thought a well dressed engineer wore, some people laughed in my face, but if they had been at the Homecoming Dance they would have been amazed at the quorum of engineers present. Contrary to the belief that all engineers do is study, you can always find them around where things are happening. One of the chief virtues of the men in this profession is that they are very active outside their own field in their spare time.

It is during these times that we see what the well dressed engineers really like. They have been known to outshine all others. It is possible that an engineer of some sort has a finger in the designing of the new fashions since one of the main features in modern clothes is genuine comfort.

"Sport coats . . . almost every color"

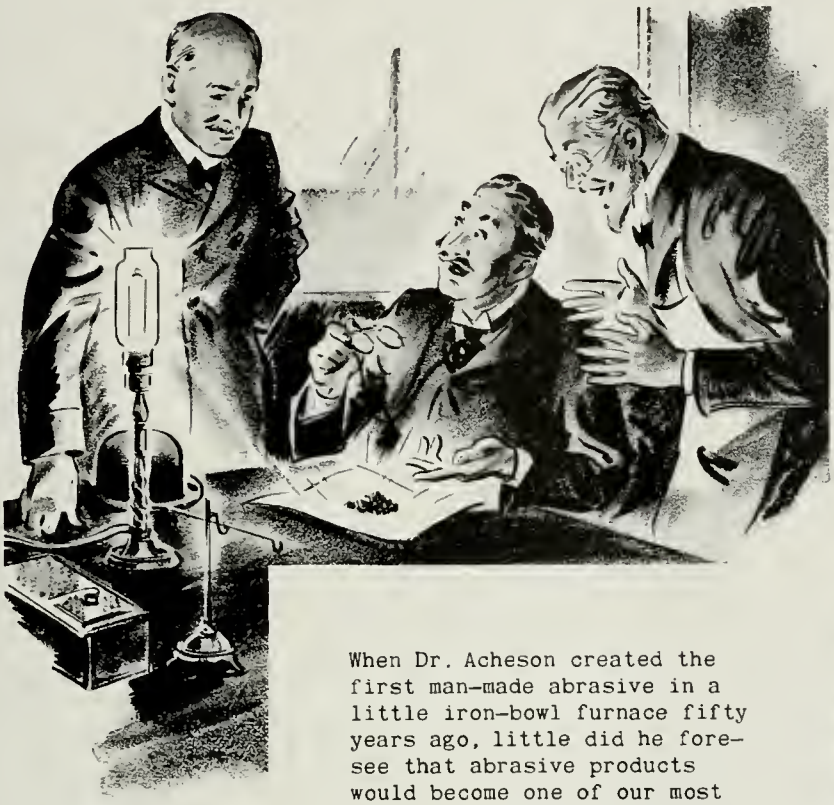
I don't think that I am going too far when I say that the Illinois engineer ought to be the best dressed engineer in the country with "the world's most outstanding college store" right on the campus. The principal purpose of the clothier is to provide the public with the clothing that they want to wear. With this in mind several outstanding stores have been established here on the campus. If any of you have any ideas about something that would make a hit with the students, talk to the managers and they'll tell you what can be done with your ideas.

The Illinois engineer prefers a modified style along the lines of the M.I.T. men. The men in the east prefer the sack coat, while the mid-western men like the natural shoulder line with a slight suppression at the waist. Everybody is leaning toward the browns and tans of covert, flannel or tweed cloth.

In sports coats the engineer prefers the browns and tans again, but this time in a blazer of houndstooth pattern. With the sport coats we find almost every color of

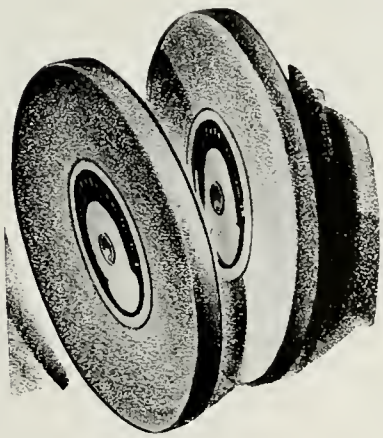
(Please See Page 20)

Was $880.00 a pound...NOW 16¢!



"You really made these crystals in an electric furnace?" the gem expert asked. "They look as if they'd been in the earth a million years!" "Certainly I made them", said Dr. Acheson. "And all I ask is that you crush them and try them instead of diamond dust for gem polishing." The expert did...and placed an order at $880 a pound! Today this same Carborundum Brand Silicon Carbide serves all industry, sells in grain form for as little as 16¢ a pound.

When Dr. Acheson created the first man-made abrasive in a little iron-bowl furnace fifty years ago, little did he foresee that abrasive products would become one of our most important production tools... that one day they would be used in the grinding, finishing, shaping and polishing of practically all the products of all industry.



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TECHNOCRACKED . . .

By Robert E. McCleary
Junior in Mechanical Engineering

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Foreword: Any resemblance to humor found on this page is purely coincidental . . . .

Well, the E.C.M.A. (Engineering College Magazines Associated) Convention has come and gone. Great affair; how many of you engineers attended the banquets and entered into the spirit of the thing at a buck twenty eight a throw?

Oh well, the thing to think of now is Christmas. Ah joyous Yuletide . . . . a time of year when everybody exchanges the things he got and didn't want the last time for articles somebody else got and didn't want — a very vicious cycle indeed—reminds a Thermo student of the Carnot cycle—everything added being eventually returned in slightly different form. You can't beat the law of conservation of energy.

Clothes are nice to get for Christmas, and incidentally, you might glance at Bill Murphy's article on engineering sartorialism in this sheet. 'Seems as though the prime requisite of an engineer this season has been a slide rule and a canoe.

Confidentially, L.A.S. (Loaf and Smoke) men, a slide rule will not do an engineer's homework for him, all comments by Don Herold, of the Keuffel and Esser ads to the contrary. They sure help in long calculations, tho . . . . incidentally they are no help to this engineer's budget, for such quantities seldom exceed two significant figures and can more easily be calculated digitarily.

Since Rhet classes are held in the Transportation Building, the so-called 'Wilds of the Engineering Campus' has been brightened considerably with feminine pulchritude*. Did I say pulchritude? Well, anything looks good to men who have spent as many as four in classes absolutely devoid of real, live girls.

(*Note the two-bit word employed. Technocracked is definitely being conducted on a more ethereal plane of late, or had you noticed, gentle readers? It is not absolutely true that engineers are engineers only to avoid excessive theme writing, altho you'll admit that is a good idea.)

Bill Mareneck (Moronic, for short) Junior M.E., has committed a first order blunder by becoming scholastically outstanding in M.E. 13—a hundred in the first hour exam, imagine! Let him beware the blasphemous epithet of D.A.R. (Damned Average Raiser) which will inevitably be fastened to him if another faux passe of this sort obtains.

Mrs. Olson's little boy, Chester, (M.E. '43½), is a Cadet Lieutenant in the R.O. and a new T.N.T. member. "Lootenenant' Olson claims to be the only T.N.T. man who wore 'Civies' almost entirely during the four week pledge period, and who didn't carry gum, engineers mints (Feenamints?) and cigarettes at all times . . . Didn't even know what a 'bomb circle' was, in fact.

Elmore Mays, Junior M.E. and Lambda Chi from the University of Tulsa, has been barreling his snappy yellow Ford convertible to classes in the Transportation Building every day of late. He'll never get picked up for driving too fast but may get grounded by the Aeronautical Commission for flying too low. Elmore is really quite a modest boy, tho—only thinks he's half as good as he knows he

really is . . . . only occasionally wonders why he wasn't born rich instead of so handsome.

Well, the automotive industry has come thru with 'the goods' again this year. The thought of sometime owning one of these racy new models is often the only incentive engineers have to keep them shoving their 'Slip-sticks' thru the maze of home problems that is every engineer's lot. The new low independent springing has made the position of the fat pedestrian much safer—drivers avoiding them in order to keep from gumming up the works.

During the Homecoming orgy one motorist was known to remark to his friend while driving back from the country, "ssay, yau know ppal, we're gettin closher and closher to the city?"

"What mayksh, yau think sho?" lisped his companion.

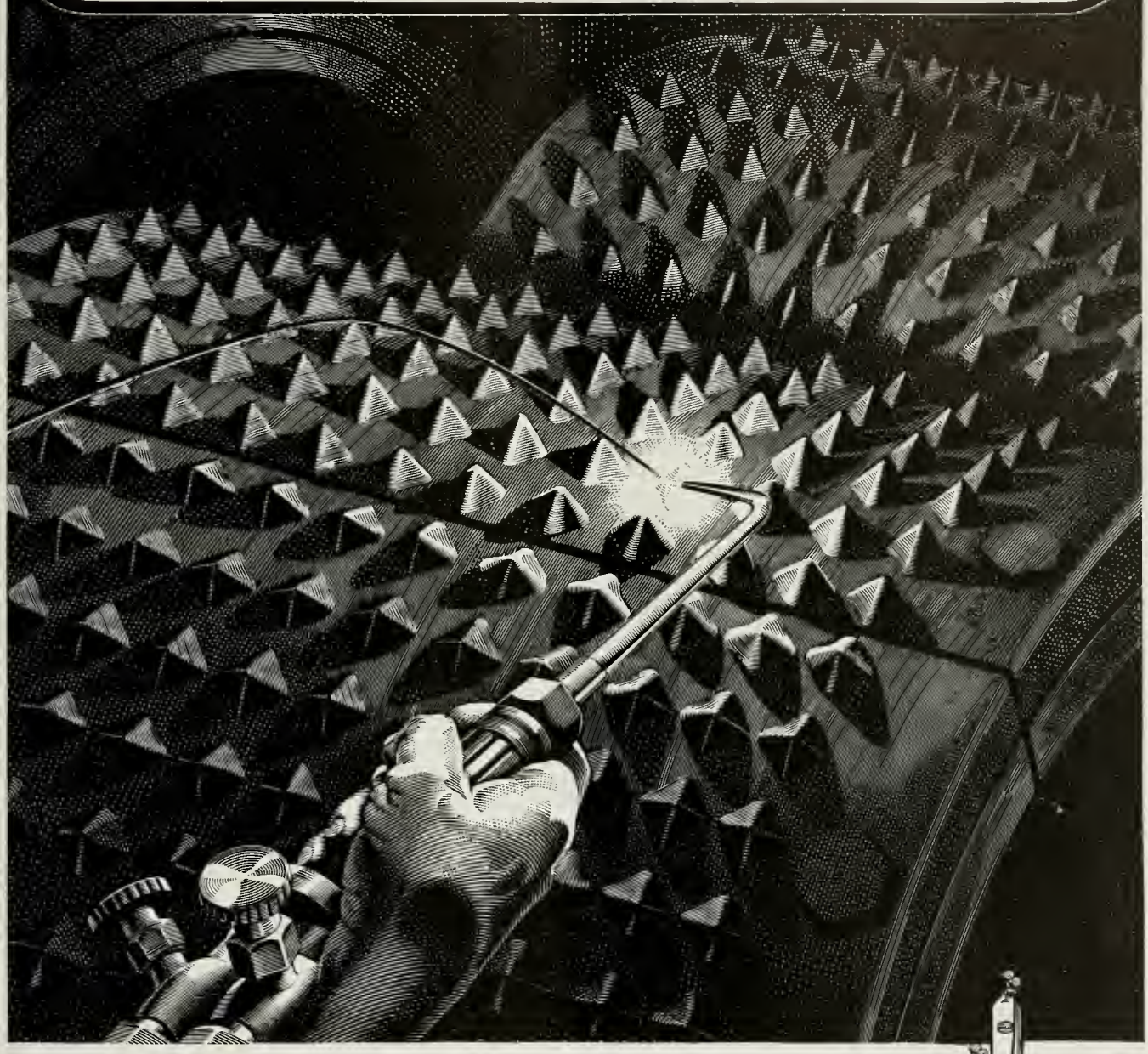
"Well, we're hittin' more people aren't we?" the other replied analytically.

Technocracked intends to find out whether upper class engineers really cross themselves and Salaam toward Engineering Hall and the M.E. Lab. at the mention of the names of Professors Ensign and Leutwiler, respectively. Did Prof. Leutwiler actually flunk his own son in a design course, or is that another rumor?

This page has been a bit off the cob, hasn't it? (SHUT UP!) Well, like the customer saying 'It Looks like Rain,' and the waiter replying, 'I know it, but it's still soup,' it looks as though it can be anything from here on in.

P. S.: A tommyhawk is what if you go to sleep suddenly and wake up without hair, there is an Indian with . . . . don't blame that one on us, we plagiarized it from The Arkansas Engineer, which no doubtless plagiarized it from some other engineering journal . . . . So what! The campus bywords now seem to be "Beat Hitler"—We've beat few enough others this fall.

"FACE-SAVING" 20th CENTURY STYLE



WORN teeth no longer render crushing equipment useless, nor do they mean long, costly delays. Today there is a simpler, faster, less expensive way — hard facing with the Airco Oxyacetylene Flame. Reports indicate that teeth built up by this proved Airco process last longer, yet cost only 25% of a new segment. Cost of replacing the entire crusher is, of course, far greater.

Airco Hard-Facing is a versatile process. Wearing parts of varying shape and size can be rebuilt economically, speedily. Standard oxyacetylene welding apparatus is employed.

Not only for maintenance of equipment, but on thousands of production lines, the Airco Oxyacetylene Flame is on the firing line speeding countless defense products to completion. It has been drafted to cut steel to any desired shape, to flame harden metal parts for longer life, to weld two or more metal parts into a strong, lasting unit, to machine metals with unrivaled speed, to clean and dehydrate metal surfaces for lasting paint jobs.

A pictorial review "Airco in the News" shows in an interesting manner these many uses of the flame. Write for copy.

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Military Christmas Presents

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PLASTICS FOR CHRISTMAS

. . . . *from page 7*

Among the attractive articles for Dad this Christmas will be found flashlights with cases of attractive colors of plastic and with an unbreakable lens of the same material. This type of flashlight is even more rugged than its predecessors and lengthens battery life. Or perhaps he would like one of those plastic belts, new golf clubs with durable heads of plastic, a safety razor with plastic handle, or a modernistic chair-side ash tray moulded in irresistible plastic.

"Look at all the practical things we can choose from to please Mother on Christmas!" Examine all the kitchenware with beautiful, heat resisting plastic handles. Those plastic bowls, measures, and funnels will delight her! And one is postive she would think those salt and pepper servers of colorful plastic are "just the thing" to help carry out her kitchen color scheme. Perhaps she would like some of those "gorgeous" artificial flowers ingeniously made of deep-colored plastic to ornament the mantle-piece. And one of those plastic cleansing tissue dispensers would be convenient as well as attractive.

Did you want to get Sis some nice book-ends, but found it rumored that all the stores are sold out of those bronze ones and the factory which makes them have discontinued manufacture?" You needn't worry, for look at all those new plastic book-ends you can choose from, and she will like them much better than those of dull bronze. Wouldn't she be 'thrilled' with one of those new style handbags of a specialty developed pliable and durable plastic in woven and laced tear-drop patterns? Aren't those plastic dresser lamps 'just perfect'? Perhaps she would like some of those clear polystyrene curlers which are chemically resistant to hair lotions, or one of those compacts with double beveled glass mirror which may be used through the transparent plastic cover.

As for Brother, there are hair and clothes brushes with plastic handles and nylon bristles, excellent carpenter and machinists' tools many of which are made of a special non-breakable plastic, alarm clocks with tastefully tinted plastic cases, or a plastic-cased flashlight like the one that was gotten for Dad. He would appreciate a large new plastic floor lamp to place by his easy chair in his room, and perhaps it would be a good idea to get him one of those nice table-model radios with a durable plastic cabinet.

And the lists of possibilities for appropriate gifts could go on and on. Yes, our American Christmas traditions will remain unaltered, thanks to our Chemist friends who have developed the synthetic plastics, and to our Craftsman friends who have designed, formed, and produced with this new material the thousands of products which are being placed on the retail market throughout the land.

DEC. 4th

Mark that Down
On that day the new K & E
Slide Rules should be in

University Book Store
202 S. MATHEWS
610 E. DANIEL

LOOK! *Seat Covers* OF LUSTROUS *Plastic* FOR YOUR CAR!

THE NEWEST STYLE note in motor cars is seat covers of smooth, lustrous plastic—custom made and woven from the remarkable Dow plastic, SARAN. This innovation in car slip covers offers light, attractive pastel shades—or, perhaps, transparency to actually reveal tints of the upholstery—in every way lending new smartness and distinction to the car's interior.

Now, for the first time, seat covers in light colors are practical because SARAN is quickly and easily cleaned with just a damp cloth. There is no danger of the colors running. You can ride on these seat covers in wet bathing suits, if you like. If windows are left open, have no fear of damage from summer showers. For, SARAN is waterproof plastic.

There is plenty of ventilation with SARAN seat covers—they're cool! The smooth surface permits you to slide easily into modern low cars without difficulty or the slightest danger of catching clothes or hose. The value in these new seat covers is exceptional because SARAN will out-wear the life of the car.

While, currently, seat covers of SARAN are custom made only, they are significant of a marked trend. They provide a striking example of the constant efforts of manufacturers to adapt plastics to numerous new products.

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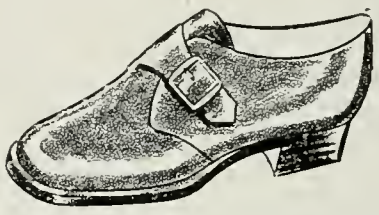
the rainbow being used, and that is a big change from a few years ago when certain colors were worn together and with nothing else. Engineers have always been conservative and now the others are following suit and getting away from the flashy styles of the last few years.

In odd jackets you will find the individuals expressing themselves a little bit more and wearing brighter colors. Another trend which may be a result of engineering practicability is the one toward more durable materials of hard finish.

For classes and sports wear the present generation on the "North Campus" prefer shoes of the moccasin type or a saddle shoe. For dress or semi-dress they want heavy brogue type shoes that follow the military trends of today.



"Shoes that follow the military trends"

This, too, may be an engineer's idea because the greater majority of men in the military service today are engineers.

In their top coats the engineers are again becoming the leaders of style since the more practical the coat the more stylish it is, and who is more practical than an engineer? The top coats are of gabardine or some hard finished material treated to repel water. They are all the knee or three-quarter length coat cut in sack lines and with a little stitching around the bottom to break the plainness. Browns, greys and greens are the predominating colors.

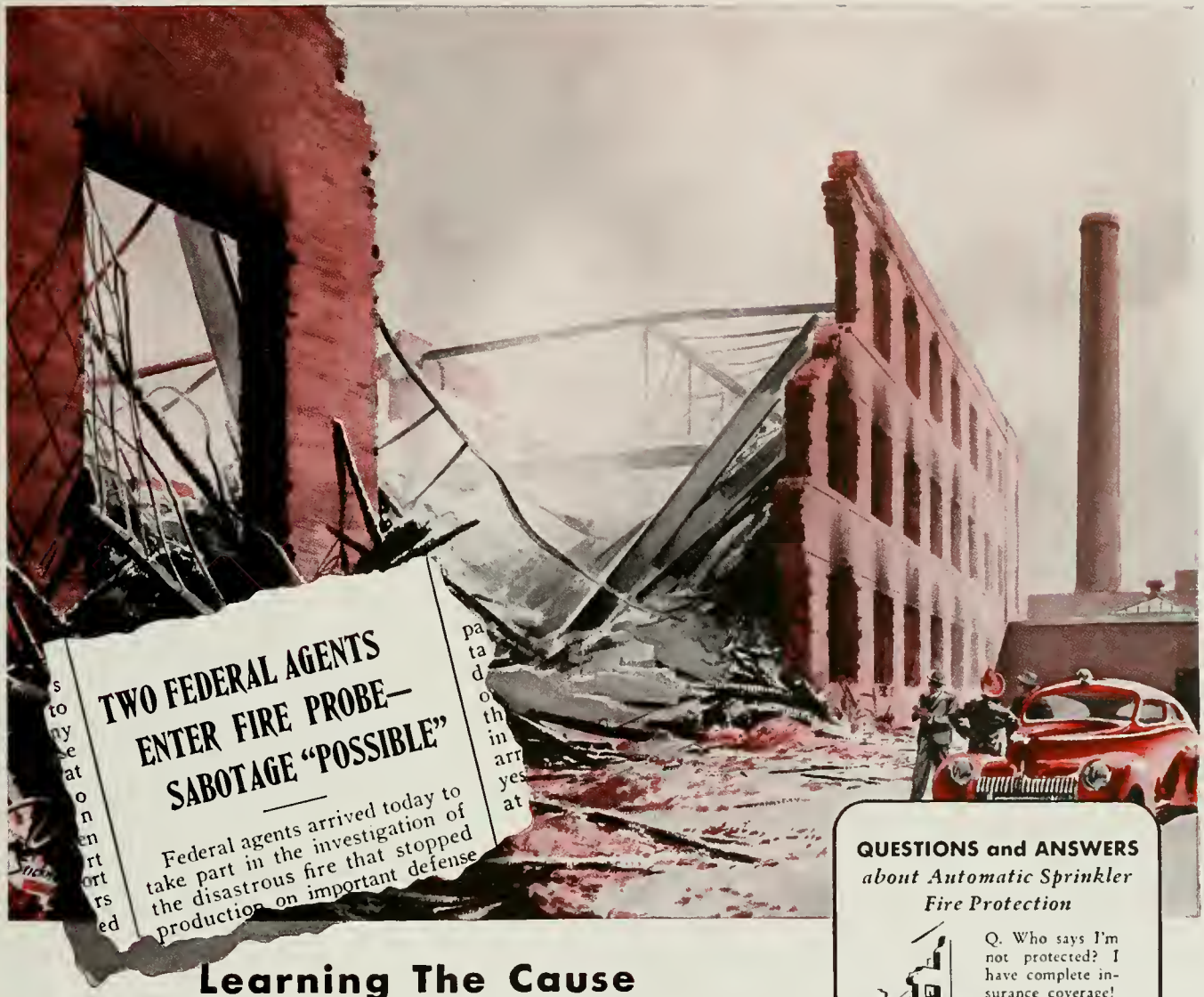
"Wide-brimmed, soft-crowned" hats

For his hats the engineer has turned to a wide brimmed, soft-crowned model with a contrasting edge of corded or gabardine material. For a knock-out we find him wearing a corduroy slouch hat of almost any color that happened to strike his fancy when buying.

In the most popular article of all, the sweater, V-necks are becoming stylish. The material is soft shetland of beige or tan color and the trend is toward imported sweaters. The sweater vest is replacing the vest in all except the most formal wear.

Raincoats are very important on this campus and these are becoming more and more dressy and less and less waterproof. It seems that no one is expected to go out into the rain anymore, since the raincoats will repel a small amount of water and after that you might as well take

(Please See Page 22)



Learning The Cause Won't Fill The Orders

The shafts have stopped turning. Hands that can set a tool-rest to a hair are wrapped around pool cues down at Joe's place. Mirror finishes on Assembly's floor are dimming over with the first hints of rust.

Learning the cause of your fire won't help. What you wanted was the chance to produce – without Fire's interruption. Perhaps you counted on a "fire-proof" building. Or on employees trained to be ever-watchful. *You can't* – as the record of thousands of fires will show. The record proves that there's only one way to stop fire at its source. That way is automatic sprinkler fire protection.

Fortunately, there isn't the slightest need to compromise with quality when you install it. For the world's best-known fire protection system – Grinnell – can be bought as an actual cash-dividend-paying investment. The chart below proves it.

Built lock, stock and barrel by the world's leader in fire protection; prefabricated to a Grinnell-engineered layout, then installed with minimum disruption; proved dependable by eight thousand fires killed in the past ten years alone – a Grinnell System is the best guardian of spinning shafts your plant can have. Owners of fifty billion dollars' worth of the world's property have chosen it. Take *your* first step today. Write Grinnell Company, Inc., Executive Offices, Providence, R. I. Branch offices in principal cities.

QUESTIONS and ANSWERS
about Automatic Sprinkler Fire Protection

Q. Who says I'm not protected? I have complete insurance coverage!

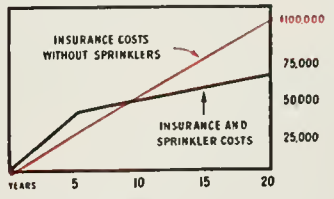
A. 43% of all burned businesses are never resumed, regardless of insurance.

Q. My building is metal; its contents are non-combustible. Why should I have sprinklers?

A. A metal mill burned to ruins in an afternoon. Oil vapor had condensed on inside walls.

Q. What do you mean – a Grinnell System pays for itself?

A. The chart shows a typical case. Insurance without Grinnell System, $5,000 yearly. With Grinnell, premium reduction paid for the system in 8-1/3 years. After that, $3,000 a year clear saving!



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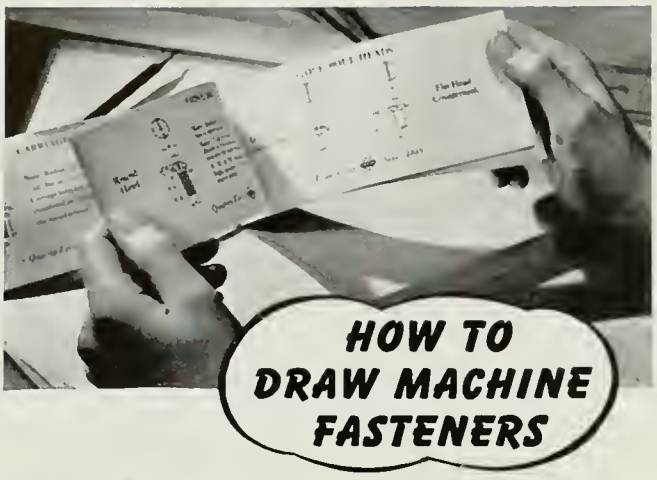

• The "RB&W Handbook of Common Machine Fasteners"—sent absolutely free upon request — shows the most widely accepted methods of representing more than thirty different types of standard bolts, nuts, rivets, etc., on assembly and detail drawings. This 16-page booklet will fit inside your drawing instrument case for handy reference.

No actual dimensions or specifications are included, as the proportions and conventions shown apply to all sizes of fastenings.

To get your copy of this valuable little booklet, just send a postcard to our Port Chester address.

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them off, for all the good they do you. These new "jobs" are of three-quarter length on the theory that the rain is coming from above and therfore your feet don't need protection. Pants pressers certainly do a land office business after a downpour. Perhaps there is a coalition between the tailors and the waterproof wear manufacturers!

Around the campus and everywhere else there is a prevalent trend toward the three-quarter length jacket which comes under the name of "station wagon", "finger-tip" or "reversible" coat. The zip-in lining is popular with this type of coat, making it serviceable in all types of weather.

Everyone is getting as practical as possible these days, hence, the trend toward durable materials and neutral colors. The hard-finish coats and trousers are replacing the soft shetlands and camel hairs. The most popular of the new materials include covert, gabardine and corduroy.

In his odd slacks the engineer prefers cords, covert or plaids and tweeds. The tweeds, coverts and cords again feature the browns and tans, while the plaids go to any extreme that you wish.

Socks will always be the key to the individual; no matter what the style everyone wears the colors or styles which he prefers. The 12/3 rib is one of the popular sellers for a plain color sock and the striped sock in the three-quarter length remains the most predominate of all.

Ties are receiving a lot of attention lately. The new French stripe on a silk tie or a plaid wool can be seen almost anywhere these days. In the future men will be wearing ties of nylon, following the women who have given up silk to national defense. The trend to wrinkle-proof material in recent years is the most lasting fashion of all men's wear.

Last but not least we have the shirts. Once more we find the styles to the convenience of the engineer. In shirts the wide sloping collar is the style. This collar is laundered without starch and is given its appearance through the use of stays or buttons attached to the shirt.

You probably haven't met engineers who were more than one-fourth of the so-called stylish models. But as a class the boys are rather well-dressed and individual. How do your ideas in dress compare with those outlined above?

Another paper announces that travelers who wish to enter Italy now must give a reason for doing so. It seems to us that the type of person who would wish to enter Italy now wouldn't be capable of reasoning.

Frosh: "Ever do any public speaking?"
Senior: "Yes, I proposed to a girl once over a party phone."

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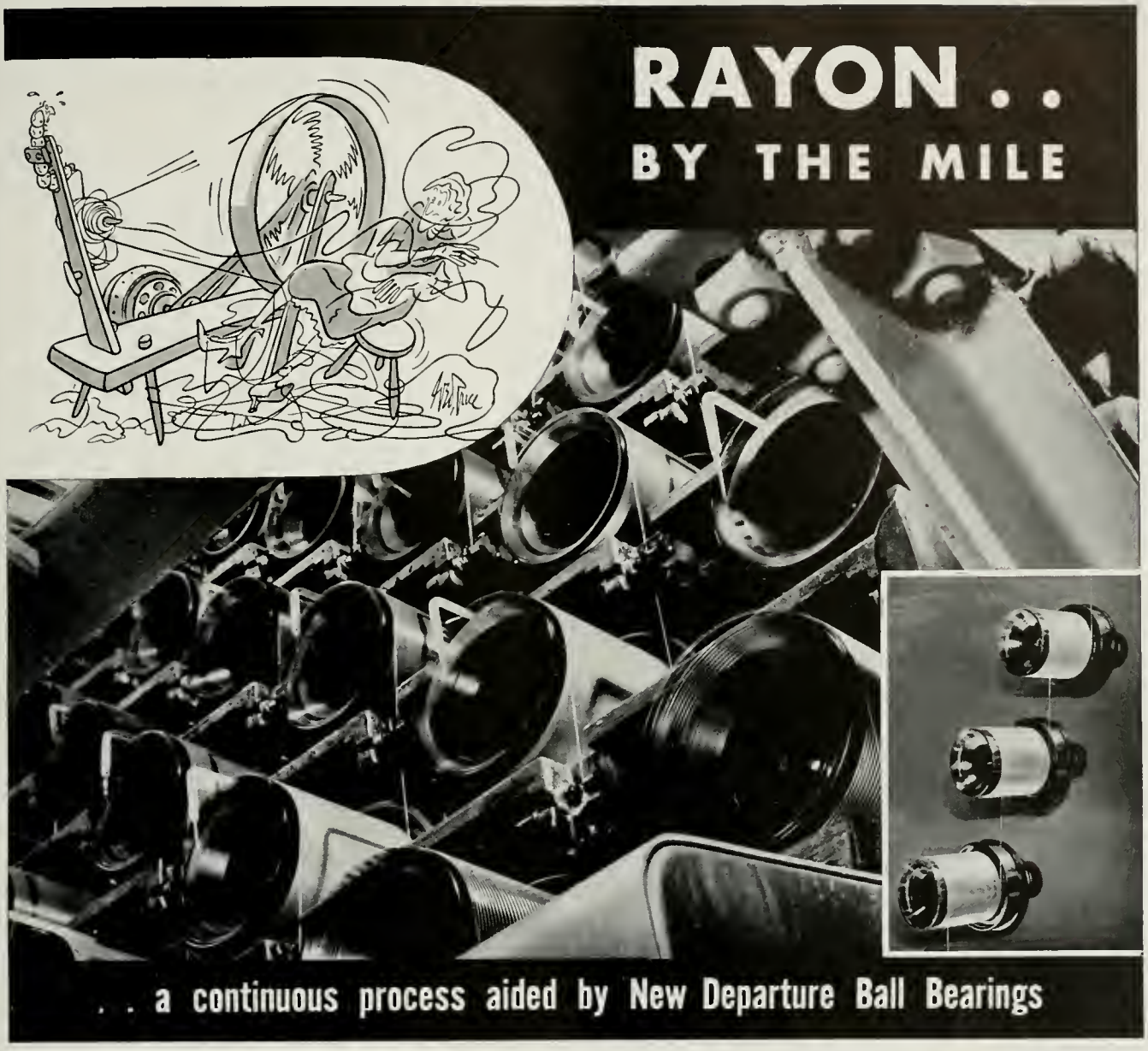
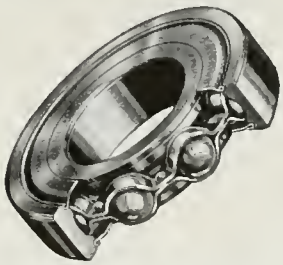


● The lowly silk worm has become old-fashioned indeed. Now, from liquid Rayon, finished thread is manufactured and wound in one continuous process—ready for the textile mill.

But the 100,000 reels and spindles of this great plant could not operate continuously without the friction-reducing, wear-avoiding qualities of the New Departure self-enclosed and lubricated ball bearings at more than 300,000 points. In fact, they make such a project commercially possible—simplify design, accurately locate rotating parts, eliminate periodic oiling and definitely reduce costs.

New Departure Forged Steel Ball Bearings are literally the *life* of any machine. Nothing rolls like a ball.

3052

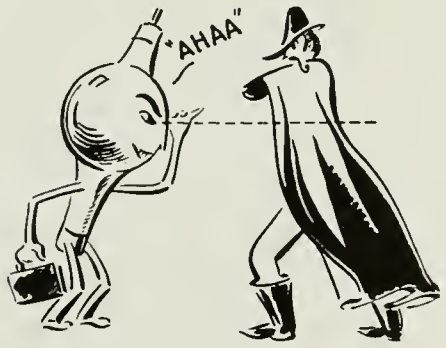


This self-enclosed ball bearing is only one of numerous "new departures," the result of New Departure's well known creative engineering. Engineering students should be interested in booklet "Ideas by New Departure Engineers," for the practical use of the machine builder. New Departure, Division of General Motors, Bristol, Connecticut.

New Departure

BALL BEARINGS FOR DEFENSE

G-E Campus News



SUPER-PEEKSTER

EVEN when our defense "Sherlocks" can't, x-rays *can* "see right through" potential saboteurs and their hidden bits of destruction.

Without unwrapping or any dangerous tampering, suspicious packages may be inspected quickly and safely. Portable x-ray equipment is also used for fluoroscopic examination of overstuffed furniture, mattresses, or other articles in which questionable items might be hidden.

The x-ray has been instrumental in unearthing such things as a hypodermic needle and some narcotics cleverly hidden in a woman's handbag, a revolver baked in a loaf of bread, or hacksaw blades concealed in a cake of soap.

CURVES OF COLOR

THE most expert human eye can distinguish about 100,000 different colors, but that's practically color-blindness compared to the 2,000,000 that the G-E color analyzer can detect. The color analyzer can even measure your lady friend's blush, provided she holds it for two and a half minutes, and then, it will record it on paper for future reference!

The recording photoelectric spectrophotometer (that's the color analyzer's name) is only one of the things you can see in action in one of G.E's newest movies, "Curves of Color." This film, in full color, gives a 10-minute story of the world of color, telling why accurate color recognition is of such great importance to man and industry.

"Curves of Color" (16mm, sound) is purely educational and will gladly be lent to organized groups without any charge but the transportation costs. If you would like to show it at one of your dinners or club gatherings, just drop a line to Campus News, Dept. 318-6, General Electric Company, Schenectady, N. Y.

HOT DOGS AND COLD DIPS

THE strip mine of the Truax-Traer Coal Company in Fiatt, Illinois, hasn't actually been invaded by picnickers (yet) who want to cook hot dogs in the dipper of the big, 30-yard stripping shovel there, but it's an idea! Hot plates have been installed in the dipper, and Calrod heating elements have been put in the dipper handle.

The purpose of these heaters is not, however, to provide an extra service for possible picnickers, but to keep mud from freezing to the sides and bottom of the dipper. This used to reduce payload 50 per cent or more, and bonfires and a shutdown of 30 minutes to an hour were necessary to thaw out the frozen mass.

GENERAL ELECTRIC

953-28-21

ILLINOIS TECHNOGRAPH

JAN 15 1942

January 1942

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UNIVERSITY OF ILLINOIS

Reinforced Concrete

Optical Highlights

Names in the News

New Car Springing

Technocracked

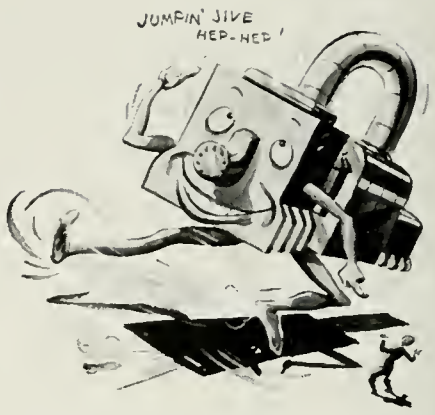
RIGHT
JUN 29 1942
★
DEPT. ARCHITECTURE

Left: Mammoth concrete spillways of Boulder Dam are designed with aid of Concrete Research at Illinois.

hed 1885 Member E.C.M.A.

20¢

Once there was a jitterbug that weighed 800 tons!



How Westinghouse Engineers Made Vibrating Turbine Generators Calm Down

WHEN the two-pole turbine generator came along, it was hailed as a great thing. And it was. It delivered enormous amounts of amps and volts, did a titanic electrical job. But . . .

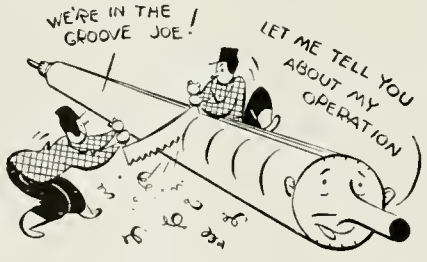
Its rotor vibrated and endangered the alignment of the bearings, collector rings, and brushes. Its stator vibrated and made the foundations tremble. And, to make bad things worse, the vibrations were different from those found in the four-pole 1800-rpm machines—and they couldn't be eliminated by the usual balancing methods. Engineers had a tough problem on their hands.

► Westinghouse engineers studied the rotor and found that it was acting like a two-by-four piece of wood. A two-by-four sags more lying flat than lying on its edge. It was the same with the long, slender, two-pole rotor. It sagged more lying one way than another.

This was why: Along two sides of the rotor, deep lengthwise slots were cut for the field windings. Naturally, the rotor had more give on the slotted sides than the solid sides. So, as the rotor turned, the give in the slotted sides made the downward force on the rotor supports change twice each revolution. The result: the rotor made the machine vibrate 120 cycles a second.

► What to do?

Dummy slots in the solid sections of the rotor would have equalized its rigidity. But Westinghouse engineers did something better. They cut several grooves across the solid sections. These grooves made the rotor's rigidity equal on all sides, *without disturbing the magnetic flux*. The turbine generator worked at top efficiency, the vibration at the supports was reduced 88%, the rings, brushes, and collector rings didn't take such a shaking-up.



► That took care of the rotor. But Westinghouse engineers also had to figure out what to do about the stator vibration.

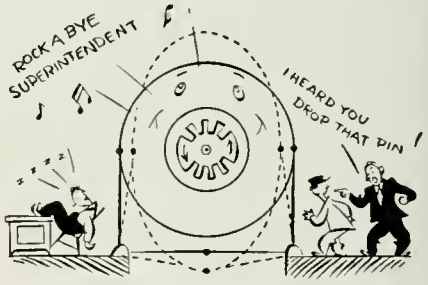
Massive as it is, the stator was being pulled out of shape, first on top and bottom, then on the two sides. The 400,000-pound magnetic force of the two-pole rotor was doing the pulling as it turned.

► Of course, the change in the stator's shape was too minute to be seen. But it could certainly be heard. For this change in shape was transmitted to the stator foundation as a 120 cycle vibration. From the foundation this vibration travels to floor and walls, making them hum.

To put a stop to it, Westinghouse engineers developed a special, flexible mounting for the stator. It is as though the stator were supported on two sets of links. One set goes along with the stator when it vibrates horizontally, but doesn't budge when the stator vibrates vertically. The other set goes along with vertical but not with horizontal vibrations.

► The effect of this ingenious arrangemen is that there is no motion at all where the links are attached to the stator foundation! The vibration at the supports is reduced by 75%, the noise lowered to less than ordinary power station noise levels!

The job was done. Stator vibration was absorbed. Rotor vibration was calmed down. Westinghouse engineers had 3600-rpm, two-pole turbine generators pouring out great electric power, and making no more vibration than machines running at half their speed.



► The electrical industry was through with that vibration trouble for good.

★ ★ ★

This is a typical Westinghouse story. It's typical because it's a story about engineers.

► There are 3500 engineers in Westinghouse. They're in all branches of the business . . . management, research, sales, design, service, testing. They shape the company's attitude toward its work.

Engineering is the heart of our business. Engineers create our products. Engineers solve our problems. Engineers determine our success.

Westinghouse

"An Engineer's Company," Westinghouse Electric & Manufacturing Co., Pittsburgh, Pa.

JANUARY ★ 1942

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Published Eight Times Yearly by the Students of the College of Engineering, University of Illinois

Published eight times during the year (October, November, December, January, February, March, April, and May) by The Illini Publishing Company. Entered as second class matter, October 30, 1921, at the post office of Urbana, Illinois. Office 213 Engineering Hall, Urbana, Illinois. Subscriptions, $1.00 per year. Single copy 20 cents.
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No **GUNS** *without* **GAGES**

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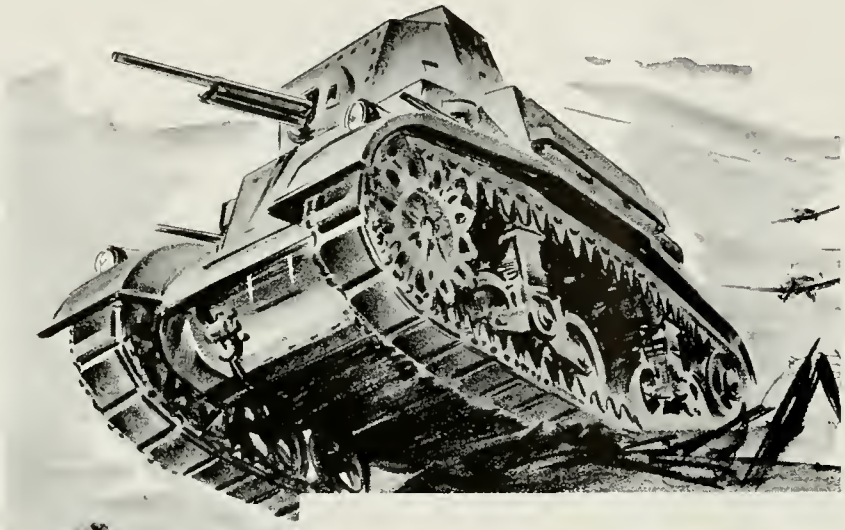
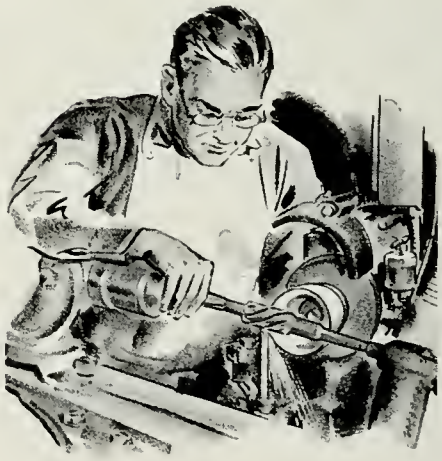
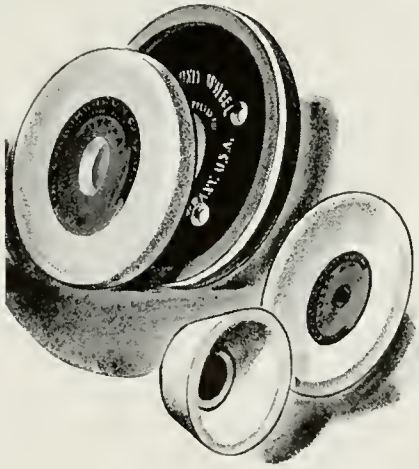


It's the first tanks, bombers and guns that make the headlines. But it's their steady day to day production that really counts. And it's keeping machine tools operating at top efficiency that makes this possible. This calls for the regular grinding and conditioning of every tool and die...a task that is done in the tool rooms of industry, where Carborundum-made grinding wheels are doing one of their most important defense jobs.

Thousands of vital parts are being turned out by the reamers, milling cutters, broaches, hobs, drills, taps and dies that Carborundum-made tool-room wheels help keep at work on the production lines. Carborundum Brand Diamond Wheels are speeding the grinding of cemented carbide tools, and special Aloxite Brand "AA" and other types of cool-cutting wheels are grinding tools of steel.





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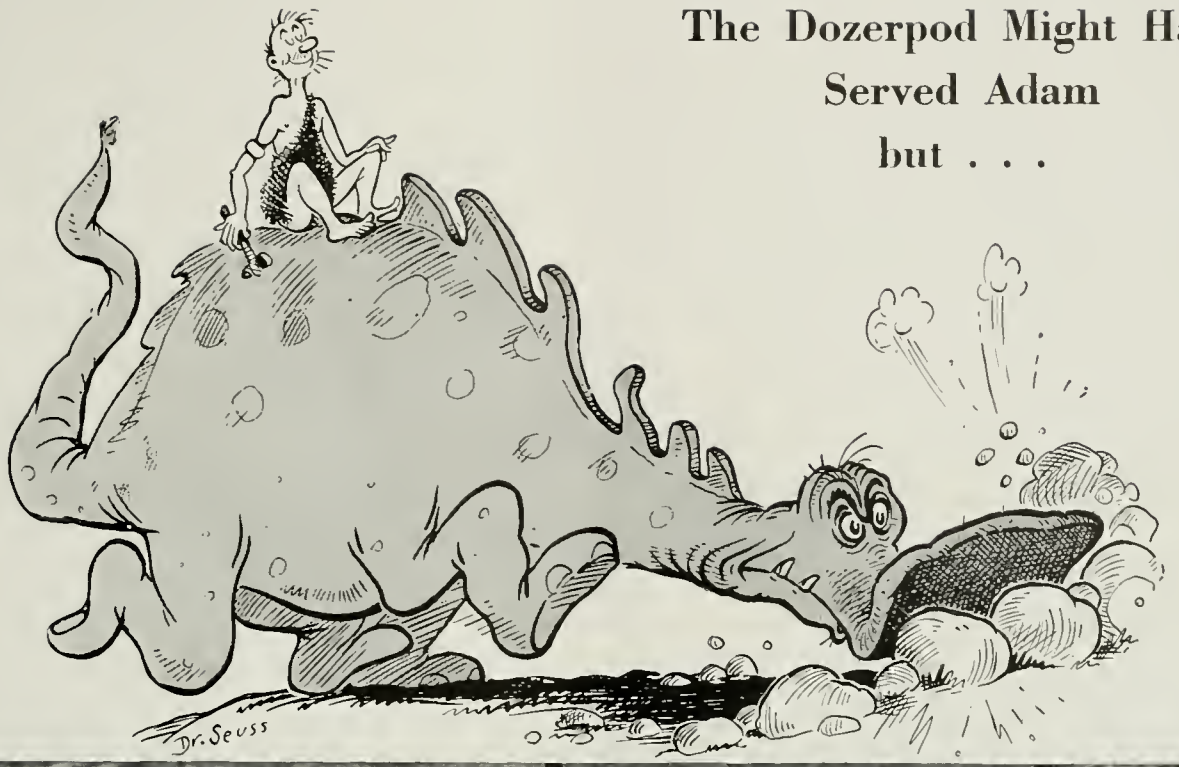
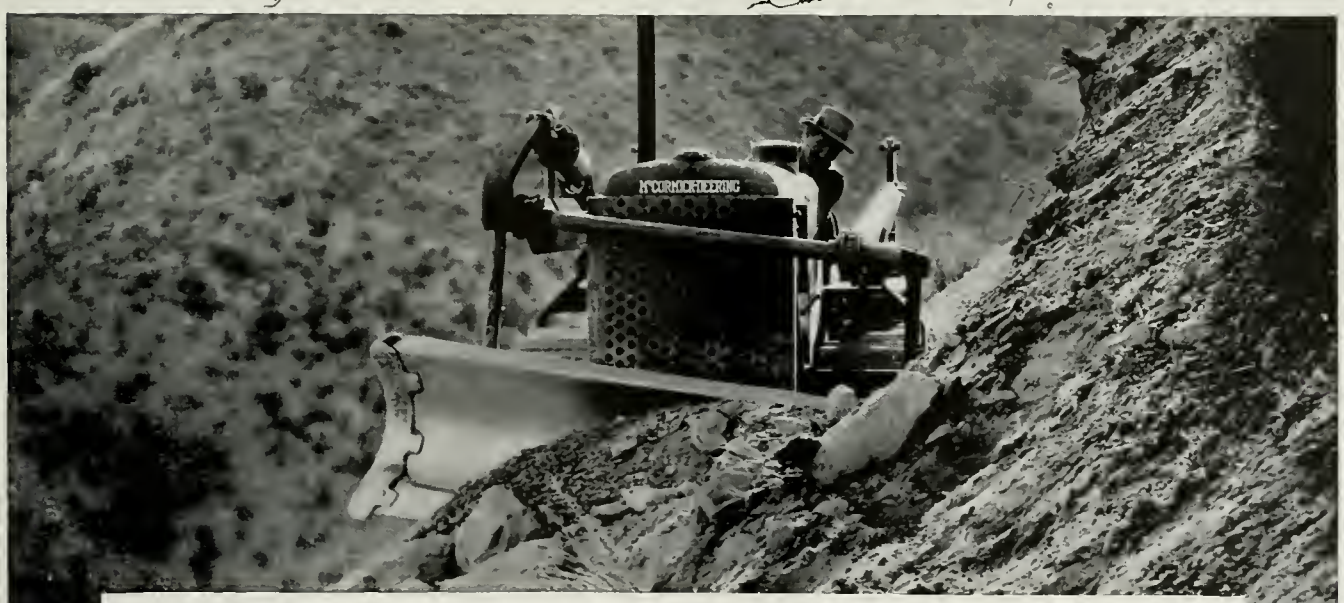
The Dozerpod Might Have Served Adam but . . .





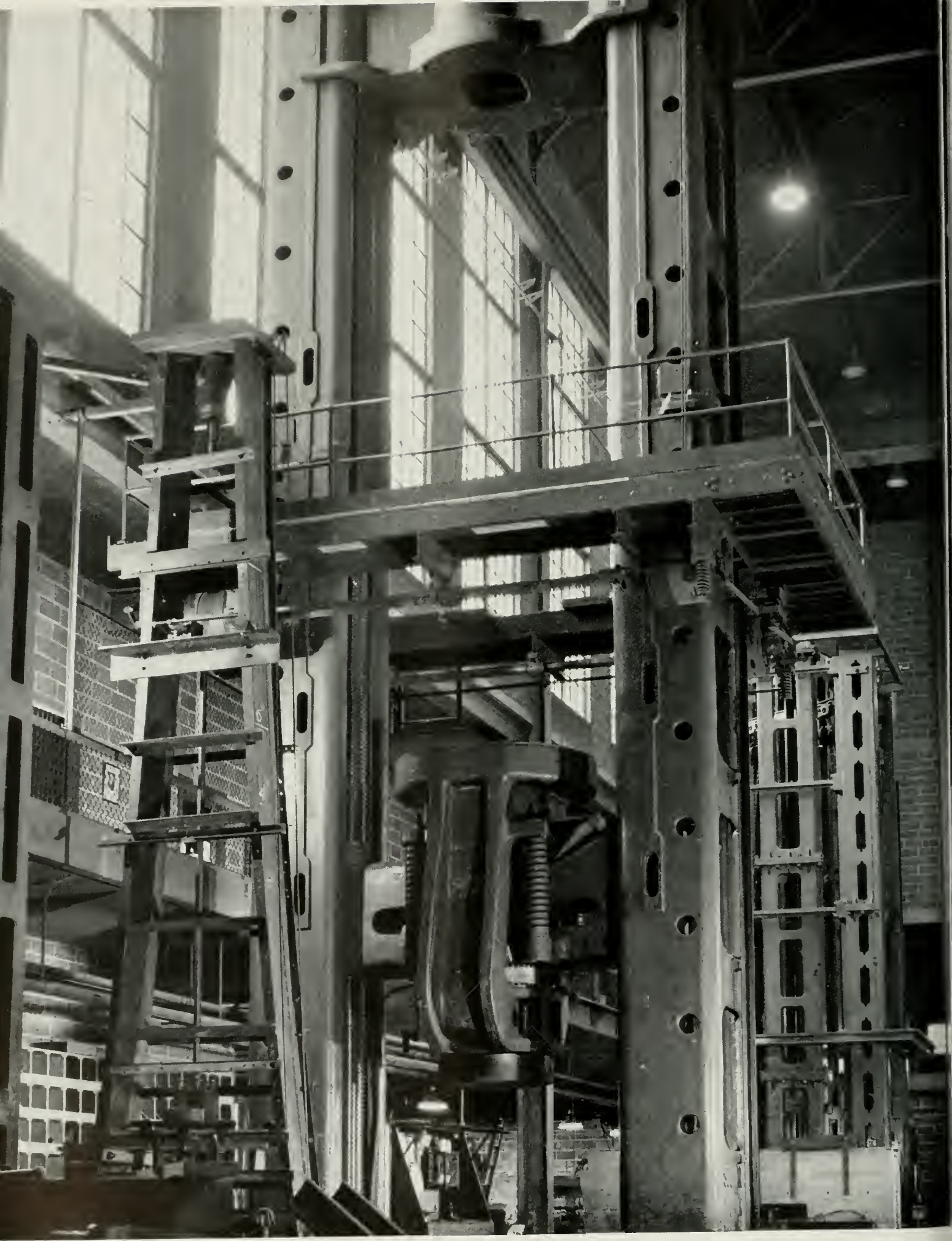
. . . Mechanized Equipment Does It for Uncle Sam

Back of beyond where defense begins, bulldozers and powerful tractors are carving out roads and supply lines where such were never dreamed of before. And in these hard-working machines are quantities of tough New Departure ball bearings, forged of the finest steel for high capacity and long life in their vital jobs.

New Departure, Division General Motors Corp., Bristol, Conn.

3058 **New Departure**

BALL BEARINGS FOR DEFENSE



"Symbol of Illinois Research . . ."

TALBOT LABORATORY CRANE BAY

Outstanding Research

. . . under the Orange and Blue

By William G. Murphy
Junior in Civil Engineering

The University of Illinois is one of the best schools in the country today, yet her reputation isn't spread far and wide by her graduates as is the reputation of M.I.T. and Cal. Tech. One reason for this is the ignorance of students of the background of historic work which has made Illinois the outstanding university of its kind in the world.

THE TECHNOGRAPH will attempt in a series of articles to outline what has gone toward making this the best school in the country. We hope that this series will be a step toward the rallying of the student body around the colors of Illinois to give her the credit she deserves for developing the men who become leaders of our country.

Test Frames Under Sustained Loading

Investigations in Reinforced Concrete—1903-41

Since 1903, when the Engineering Experiment Station was established by the Board of Trustees, a large percent of the investigations in the field of concrete has been done at the laboratories of the University of Illinois. Much of this experimentation has been directed by Prof. A. N. Talbot, whose work was given impetus by the organization of ASCE, ASTM, AREA, and other societies to promote investigation in concrete.

Consequently, Talbot conducted a series of tests on reinforced concrete which were published in Bulletin No. 1 of the Engineering Experiment Station. The years 1904-09 saw a series of tests on reinforced concrete columns, footings and culvert pipe. The findings of Prof. Talbot and his assistants were reported in bulletins published by the newly founded experiment station.

With these early developments in testing as a basis, the department expanded, with the men conducting individual investigations as well as cooperative work. Assisting Dr. Talbot at this time were W. A. Slater and D. A. Abrams. Abrams conducted an elaborate series of tests on bond in the years 1908 to 1912.

Prof. Talbot, Slater, Abrams, and others made a series of tests on the use of concrete in building structures in 1910-11. These tests were made by selecting large concrete buildings in the larger cities, placing loads on a certain floor, and measuring the effects such as the deflection on the floor and deformations of the materials composing the floor.

These early experiments led to the development of the strain gage by which the stretch or shortening of material under a strain can be measured. This instrument is accurate to one millionth of an inch.

The results of these early tests were included in the report of the joint committee in 1917. The findings led to a second committee to continue in the study of the properties of reinforced concrete, which reported in 1924.

The investigations were showing their effect in the improvements in the design of buildings by this time, and the tests were continued with a series on the failure of concrete beams. The department attacked this problem by designing their beams to fail for different reasons; namely, shear, steel failure, bond failure, or concrete crushing. For their findings, they attempted to improve the design of reinforced concrete beams and columns.

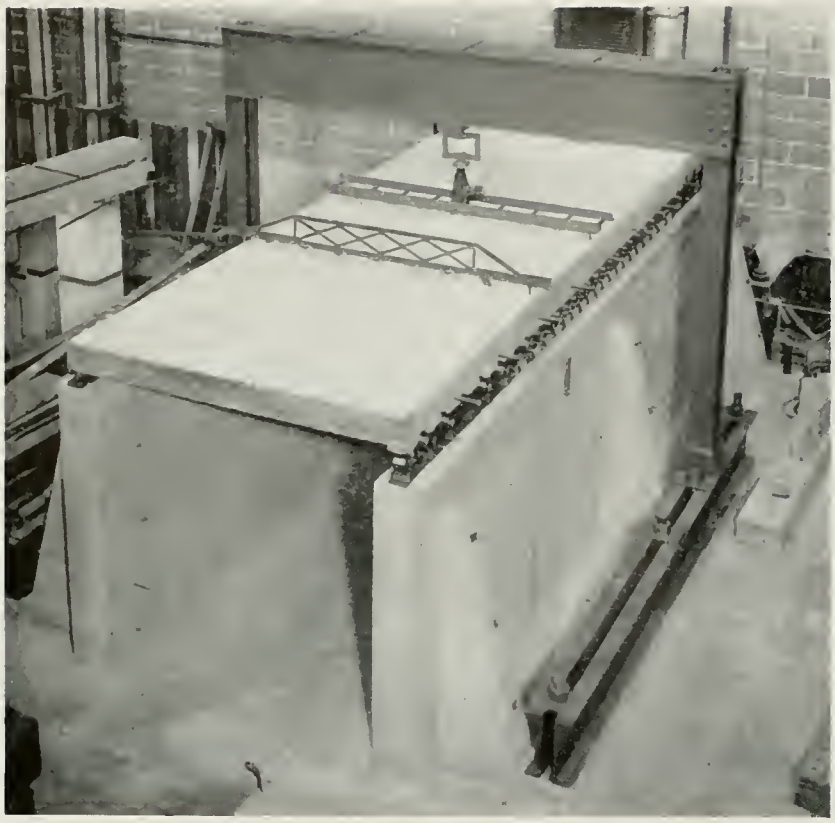
Next, Talbot and Richart made investigations in the field on plain concrete and developed the cement-space ratio method of determining the strength of concrete. Their theory of proportioning is not greatly publicized, but it is used in this state by the highway department. When D. A. Abrams left Illinois, he began a series of experiments for the Portland Cement Association, and he developed his water-cement ratio theory. Since the PCA freely distributed the bulletin containing his findings, Abrams' theory is more widely used. The Talbot and Richart theory has certain definite advantages in determining the quantities of materials to be used, however.

The development of a new formula for the design of columns was the next project of the Department of Theoretical and Applied Mechanics. They tested approximately 500 columns ranging from 8″x5′ to 32″x20′, using a compressive force of nearly 3,000,000 lbs. in the latter. Again they succeeded and a new formula was developed. About this time the stress due to the shrinkage and plastic flow of concrete in the reinforcement caused some concern, but it was proven to be of no effect on the load carrying capacity of the columns.

The new column formula was reported by the third joint committee of ASTM, ASCE, ACAE, and AIRE in 1940. The American Concrete Institute has included the formula in their publication of *Building Regulations for Reinforced Concrete* with an attempt to get the formula used extensively in building throughout the country.

Tests to determine the shrinkage of various kinds of cement, and tests to determine how the properties of concrete are affected by the speed of casting were performed next.

Frontispiece—left—The 3,000,000 pound force of the largest testing machine in Talbot Laboratory Crane Bay was used in the reinforced concrete investigations reported above.



Left: Slabs and abutments have been tested extensively in recent years. Notice the 20,000-lb. dynamometer and jack for loading.

Below: Column tests are basic in material, and stress-strain relationships were carried into structure studies.

In 1933, Prof. Richart started a series of tests on combinations of timber and concrete in a beam or slab. In such members the lower part of the beam is timber, the upper part concrete. A dozen states now have bridges using this method of construction because it combines the lesser expense of the timber with the advantages of reinforced concrete. Some of these advantages are: the smooth surface freedom from moisture rotting, partial fireproofing and water proofing. This combination of timber and reinforced concrete has been used for the construction of wharfs, heavy duty floors, and airport runways, as well as highway bridges.

The biggest investigation in recent years is the study of concrete bridge floors which is sponsored by the State Highway Department on typical examples from which a general conclusion is reached to apply to all cases. In the first tests, rectangular slabs with concentrated loads and various conditions of strength and support were used. Next, models of solid concrete slabs resting on abutments not more than 30 feet apart were tested, then tests were made on models of slab and stringer bridges of around 60 foot spans. These consisted of five parallel stringer beams of steel with the concrete floor on top. This type of structure is economical in the field, since the I-beams make it possible to do away with the falsework necessary in pouring the concrete. Finally the tests were applied to skew slabs which have been developed to eliminate the bending of a road to cross a stream at right angles. Now the bridge is designed with a skew slab to allow for this curve.

The most important part of this investigation is in the mathematical formulas which must be developed to make computations for designs. These computations provide a valuable check on the analysis. Dr. W. N. Newmark and Dr. V. P. Jensen are at work on this phase of the investigations which, according to Prof. Richart, is the most difficult part of the work.

No account of the concrete work at Illinois would be complete without an outline of Prof. W. M. Wilson's work on reinforced concrete bridges. He started about 20 years ago with a single span arch bridge having interaction between the arches and the columns supporting the roadway. From here he started on more elaborate tests on three-span arch bridges, with the arch supports mounted on platform scales which enabled him to measure the vertical reaction, the horizontal thrust, and the bending moment due to any loads which he wanted to apply to his structure. There is a model of this experiment in Engineering Hall on the second floor.

Profs. Wilson and Richart have made experiments with the rigid frame type of bridge also in the last few years, and such structures are now in general use throughout the country, for grade separations, especially. They provide an economical means of separating the grades, permitting more clearance with less depth of the fill.

It would seem as if the research men at Illinois had covered every possible angle to the use of reinforced concrete, but instead they keep right on making investigations hoping to find something new, or if they can't find anything new they attempt to prove or disprove more conclusively the findings of previous tests. All of the men are active in national concrete organizations and they are the leaders of their organizations because they take such an active interest in their work. Many have gained world recognition as experts in their field.

In addition to the research work, much time and effort is spent in the development of test books which present the material to the undergraduates. The combined progress of research and teaching go hand in hand to give the undergraduates the greatest possible opportunities.

Two microphones fit against the sides of his Adam's apple. He doesn't have to hold this "mike"—his hands are free.

How can a throat microphone help win battles?

This throat microphone is something new—made by Western Electric for the nation's air forces.

It picks up the vibrations from the flyer's vocal cords. Motor roar and machine-gun chatter don't get in to drown out his radio message. And the battle's outcome may depend on that message getting through.

This important device was developed by Bell Telephone Laboratories, pioneers in the field of aviation radio, and was made in the same workshop as your Bell Telephone.

It is among the many benefits which have grown out of Western Electric's long experience as manufacturer for the Bell System.

Western Electric *. . . is back of your Bell Telephone service*

Above. Rotating concave grinding cup grinds and polishes lens seen on holder to unbelievable accuracy. Limits of 0.0000058 inches are not uncommon; some defense requirements are more severe.

★

All Cuts Courtesy of Bausch and Lomb Optical Co.

★

Below. These girls check and record rigidly tested binoculars prior to shipping.

Optical H

By Robert E. McC

The process of converting silica s for aerial cameras, bomb sights, range painstaking research and tedious effo which locate height and range of a several tons and must be tightly sea land and sea warfare.

Range finder tubes contain lense It constitutes one side and measures whose apex is the aircraft above. Aut of the other two sides and thereby det

U. S. range finders are the world a close third. So intricate and varie single article can be called "The Nati the country's products, properly utili praise must be allocated to the gla ingenuity in providing our country w

Above. Press which forms many optical parts to approximate size.

Below. Contour maps may of Multiplex Aerial Mapping graphs throw terrain in green glasses.

ghlights

Sheldon J. Leavitt

precision optical instruments required
l binoculars is a difficult task. Much
he production of modern range finders
warcraft.. Many range finders weigh
dy to withstand the rigors of modern

end, perpendicular to the tube's axis.
jacent angles in the triangle of sight
nometric calculators supply the lengths
hip's height.

man equipment is second, and British
mponents of National Defense that no
Product." It is the aggregate of all
help save democracy. Yet adequate
al industries for resourcefulness and
al articles.

Above. Motorized truck whose tongs are removing a white hot pot of liquid glass from the furnace.

accurate fire control by use
Projected stereoscopic photo-
hen viewed through red and

Above. The broken pots yield these ice-like crystals. Inspector finds only 40% acceptable for optical purposes.

★

See Also November 1941 Technograph—"New Eyes for Defense"

★

Below. Close up of a range finder tube. Some types weigh up to two tons; a roller bearing cradle permits its turning by one man.

NAMES

. . . *in the news*

By William R. Schmitz
Freshman in Chemical Engineering

BILL BLOOD

Activity man Bill Blood is president of Caission Club, member of Scabbard and Blade, Plateau and Drum, Blue Pencil, A.S.M.E., Cadet Captain of Field Artillery, on the military and athletic councils, senior wrestling manager, and has worked with Illio and in Men's League. He is also president of Skull House.

One of his main hobbies is horseback riding, being the general manager of the recent Horse Show put on by the Caission and Cavalry Clubs. He especially likes to participate in intra-mural sports, including: Wrestling, football, basketball, swimming, tobogganing, skiing, and boat riding.

Since Bill is senior wrestling manager he has had a chance to visit other of the Big Ten schools, and doesn't think that they can compare with Illinois. Bill does a lot of dating and thinks that the girls here are a better class, both in looks and personality, than the girls on the other campuses. The spirit here is very good, and Bill says that he wouldn't ever want to go to any other school. Dances and picnics have a particular fascination.

Although Bill is in the Field Artillery, he would like to transfer to the ground work of the air corps when he enters the army, which will likely be this spring. When he comes back from the army, he would like to get into either sales or promotion work, especially the production. Bill has particularly liked refrigeration, and has a 3.8 average in mechanical engineering.

MATTHEW FINN

Matthew Finn is the industrious business manager of the Illio. Matt, as he is better known to all his friends, is also a member of A.S.M.E., Ma-Wan-Da, and vice-president of his house, Sigma Chi.

Working on the Illio as business manager takes most of Matt's time. He finds that it requires almost all of his free time in the afternoons. It was through the Illio that he received the honor of being elected to Man-Wan-Da. He finds that the Illio is not only interesting work, but it also helps his personality. Matt believes that the business education he receives combined with his engineering will be very valuable to him later in life.

BILL MATT

Matt generally spends his spare time catching up on some extra sleep or participating in some sport. He particularly likes basketball, volley ball, touch football, and ping pong. He says that the way to be able to get in activities and school work at the same time is to co-ordinate your schedule so that you have time available when your activity requires it. If a person is going to go through college he should be sure and get into some extra-curricular activity. Matt knows that it has sure helped him.

Dark-haired, slow-talking Matt believes that the co-eds are an average group of girls, particularly likes the university dances and the stag parties.

RAY CHUCK

RAY DEVORKIN

Ray is a member of Tau Beta Pi, Phi Eta Sigma, S.B.A.C.S., and president of Keramos. He has been a member of a championship intramural softball and basketball team. He also is a "pretty good bowler" on a bowling team.

Ray said that he was too busy to have many hobbies, but he guessed that playing cards, going to shows, and, believe it or not, reading *Superman* were his main pastimes. He says that he really spends more time than he should playing cards with his roommate.

Ray lists light waves, and refractories as his favorite subjects. Being a little modest about his grade average, Ray refused to commit himself, but his roommate said that it was plenty high. Ray eventually hopes to become a head of plant production in Ceramic Engineering.

The campus, Ray believes, is too large. However, it is still the nicest campus in the Big Ten. When asked about the co-eds, Ray replied, "I ain't talking, but—. My philosophy is: Life is but the ephemeral ecstacy experienced within the ethereal depths of effemenate excursions." Wow!

CHARLES SCHOTT

A musically inclined engineer is Charles G. Schott. Charles, better known to his friends as "Chuck" or "Buck," is the man behind the scene in the productions of the Star Course. As senior manager of the Star Course, he is kept very busy and generally puts in about 16 to 20 hours a week on the job.

Chuck is in other activities besides the Star Course. He is a member of Tribe of Illini, Dolphins, Scabbard and Blade, Skull and Crescent, Ma-Wan-Da, and is a Cadet Captain in the Coast Artillery. He has also been a member of the varsity Water Polo team and the track team. Chuck is a strong, husky, robust fellow, and he used his fine physique to good advantage in putting the shot.

Chuck also has quite a collection of hobbies. One of them is collecting guns. He has been interested in, and has

(Please See Page 18)

FLAME THROWER OF THE PRODUCTION OFFENSE

LEADING the attack on the production backlog by shaping steel and building it into ships, tanks, armored trucks any many other defense items, is industry's modern production tool — the Airco Oxyacetylene Flame. It slices its way through steel of any thickness up to 30" and more, cutting it to the desired contour with unrivalled speed and accuracy. This versatile tool flame machines metal with astonishing speed; hardens steel to any desired degree and depth; cleans metal surfaces for quicker and longer lasting paint jobs and welds metal into a homogeneous lastingly strong structure.

To assure the maximum efficiency from this modern production tool, Airco has developed a complete line of machines and apparatus. Airco has increased its manufacturing of oxygen and acetylene and distributing facilities to meet the accelerating demand. So that the Airco Oxyacetylene Flame may be used most efficiently and economically, Air Reduction offers industry the cooperation of a staff of experienced engineers, skilled in the use of this modern tool.

An interesting booklet, "Airco in the News", tells a picture of this Airco production tool and the numerous ways in which it is aiding the defense program. If you want a copy write to the Airco Public Relations Department, Room 1656, 60 E. 42nd St., New York, N. Y.

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SKY HOOKS or NEW SPRINGING *for Your Car . . .*

By Robert E. McCleary
Junior in Mechanical Engineering

As far back as 1925, an excellent review on springing theory was published by Prof. James J. Guest, Institution of Automobile Engineers, entitled "The Main Vibrations of an Auto Car." It was not until 1935, however, that the results of practical applications of this theory were made public. About that time, independent springing was first introduced to the American public and studies in spring rates and weight distribution were being religiously pursued. Europe has long used various and sundry types of independent wheel suspension, all American types being foreign adaptations.

The three main factors affecting the riding qualities of a car are:

1. Spring rate . . . determines the extent of shock transmission to the passenger and of direct wheel and chassis motions caused by irregularities of the road.

2. Shock Absorption . . . provision is necessary to diminish succeeding motion of chassis caused by energy stored in springs due to road irregularities.

3. Body Roll . . . must be compensated for as the horizontal forces (centrifugal force) acting through the mass center of the sprung weight cause an outward angular rotation of the body when cornering.

Consider the first factor, spring rate (lb. per inch). Softer springs, springs which deflect appreciably with small additional loads, have lower spring rates and are being used widely in the later cars. However, these softer springs have definite limitations. They tend to cause excessive body roll in cornering and fail to return the wheel to the road quickly when sharp road irregularities are encountered at high speeds. This makes for insecure steering and decreases stability. Also, soft springs tend to "bottom" easily over rough roads and, being sensitive, tend to lower or raise the general body level excessively as the passenger weight varies.

And thus it is that we consider the second factor, shock absorption, or spring damping. To date no complete solution has appeared for damping of wheel and body movements resulting from stored energy after the passing over of road irregularities. Adequate shock absorbing devices must be free of viscous drag and unaffected by temperature change, friction and inertia effects.

Consider an automobile moving over an irregular road. The spring-mounted body has a natural frequency of its own, and often resonates to the reactions of the springs as irregularities of the road are encountered. This motion approaches simple harmonic motion if, and only if, the spring frequency of the front wheels is nearly that of the back wheels. Otherwise, severe pitching results. Most cars of today have the mass center moved forward to nearly the midpoint between the front and rear wheels, thus more evenly distributing the body weight on the wheels. This makes possible the use of springs of the same frequency on both front and rear. In addition to the above-mentioned movement, there is the separate and distinct movement of the wheels which follow the road irregularities.

Now with this picture in mind, let us consider what effects a damping device (whose function it is to dissipate the stored energy evenly in order to halt bouncing) will have in various positions of the wheels relative to the body. There are four major cases to consider in the body-movement cycle:

1. Damping on the compression stroke (wheel moving upward) with body moving upward tends to aggravate the movement.

2. Damping on compression stroke when the body moves downward a little later in the cycle is desirable, as it tends to halt body displacement.

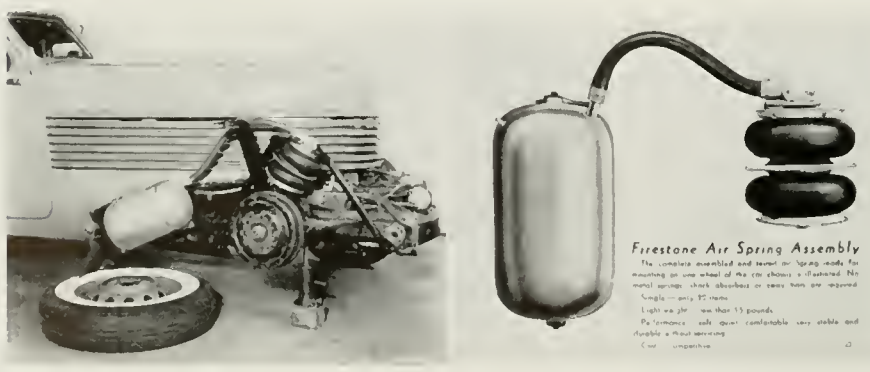
3. Damping on the recoil stroke (wheel moving downward) with body moving upward, tends to minimize body motion and is desirable.

4. Damping on the recoil stroke (wheel moving downward) with body moving downward, tends to increase body motion and is undesirable.

Actually the work cycle of an ideal damping device approaches that of the spring itself, which might suggest that the solution lies in a spring construction with inherent damping properties. Remember, that with true aperiodic damping there is no succeeding cycle. Thus there is no frequency, as the displacement from road irregularities is limited to one cycle. This is the ideal case for which spring engineers strive.

We now come to body roll, the third factor. As already mentioned, softer springs with lower spring rates, (lbs. per inch, not frequency per unit of time, which is known as the frequency value of a spring) tend to offer less resistance to the angular outward rotation of the body on curves. This action could be eliminated if the mass center of the car was below the suspension points. Designers have long tried to lower this gravity center, but without complete success. The usual method of controlling body roll has been to affix a torsional member between front or rear wheels or both. Unfortunately, such a member increases the spring rate and causes the loss of riding comfort gained by decreasing the rate in all cases except when the actions of the paired wheels are in the same direction and equal in extent, a very uncommon thing in actual road experience.

There are some other factors which give present day spring designers bad headaches. The friction of spring leaves, shackles and joints present a bad problem in relation to small vibrations transmitted by wheels moving over such surfaces as "washboard" roads. The friction of a spring system is the weight required to start deflections in the opposite direction from previous spring movement. This weight can more clearly be thought of as the weight that must be added to the fender above a wheel in order to start deflection downward when the car is idle at a curb.



Air-Spring application on the Cord front-wheel automobile of 1937.

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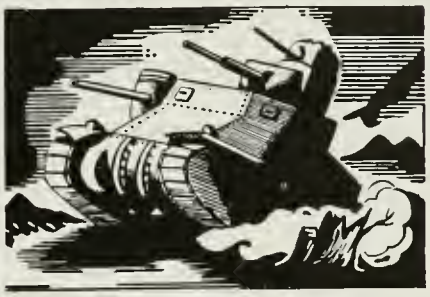
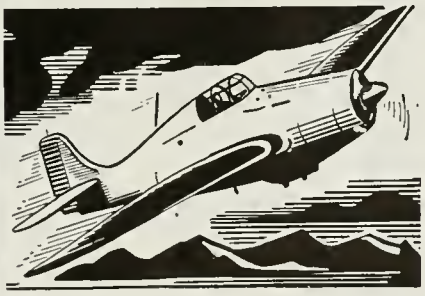
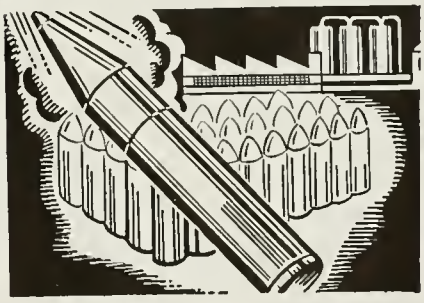




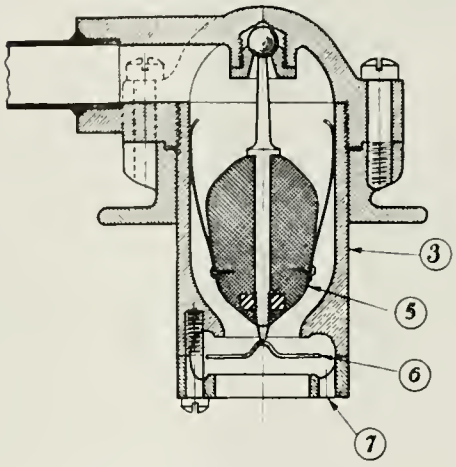


This friction is as high as 125 lbs. per wheel in some cars and as low as 80 lbs. in other cars. Actually this means that all forces from road irregularities below 125 lbs. (or 80 lbs., depending on the case) are transmitted from the wheels directly through the linkage to the body and passengers.

The high frequency of the tire oscillations is another thing with which to contend in spring design. Damping of these vibrations further complicates the shock absorbing design.

Unsprung weight causes trouble no end and is something with which few laymen are familiar. All weight not suspended by the springs is unsprung weight. This includes the wheels, tires, axles, springs, and certain parts of the linkage. Such unsprung weight is displaced every time a road irregularity is encountered. The high velocities of this displacement under abusive driving of today's conditions of high speeds together with the sharp reactions from the tire's high frequency rates, set up inertia forces of quite an unpredictable nature and frequency; unpredictable because it depends upon the speed of the vehicle and the type of road traversed, both highly varying quantities.

With all these things in mind the Firestone Tire and Rubber Co. set out several years ago to produce a suspension member with inherent damping, roll resistant, and varying spring rate characteristics and with a low natural frequency. Their answer is called the 'Air-Spring' and consists of a rubber-fabric bellows, intermediate damping valve, and an air reservoir, compressed air being the shock absorbing medium. Variation of these three elements (in size or design) make it possible to adapt it to almost every type of passenger automobile.



THE PENDULUM VALVE

Body roll and shock absorption are controlled by this simple valve. The pendulum (5) swings outwardly when rounding turns permitting valve disc (6) to close inwardly, thus producing the higher rate of the bellows available for resisting body roll. Similar action prevents nosing down from brake applications. Recoil control results from valve (6) closing downwardly, thus delaying the return of air from the reservoir by directing the flow through the restricted part (7).

An air-spring with means for axle attachment weighs approximately 2 lbs. compared with from 10 to 55 lbs. for steel springs. Thus unsprung weight is greatly reduced. In tests, this device withstood 8,000,000 2-inch deformations under 25% overload. Road tests have been equally favorable in indicating a flexing life appreciably beyond that heretofore demanded for suspensions.

Another spring of revolutionary nature has been designed by the Goodrich Rubber Co. It is called the Torsilastic spring and consists of a large tubular rubber bushing which is bonded to a frame-fixed tube and lower control arm shaft of a transverse suspension linkage. Advantages claimed are freedom from lubrication, rattles, squeaks, and less transmission of road noises. It is said to stiffen up as speed increases.

All in all, the *ride engineer* will be expected to do great things for our future riding comfort.

EASY TO READ MARKINGS THAT ARE DURABLE

Lufkin Chrome Clad Steel Tapes are today's outstanding value. Jet black markings are easy to read against the satin chrome surface that won't rust, crack, chip or peel.

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Here's the Glass pump that couldn't be built...

THE ENGINEER from the Chemical Works had one of his usual headaches.

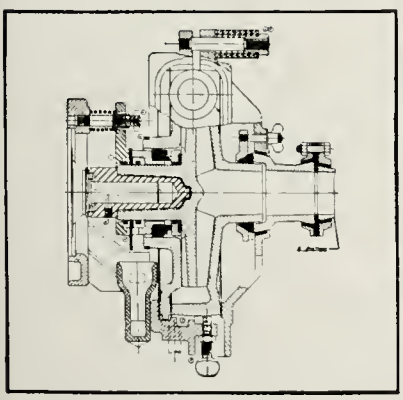
"We're pumping hot corrosive acids through your glass pipe, and it lasts for years," he moaned, "and the works bogs down because the pumps can't take it! Can't you people build a glass pump?"

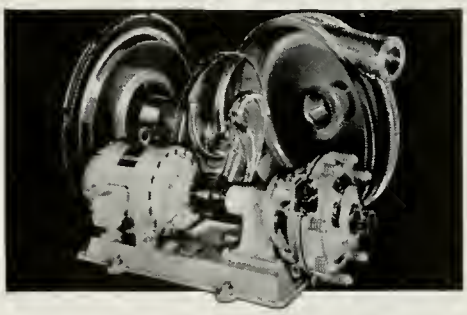
It sounded impossible. Pump makers said it couldn't be done. Such a pump required not only highly resistant glass but also intricate parts, accurate to thousandths of an inch! Even Corning had doubts but decided to tackle the problem.

Pooling its ideas with Nash Engineering Company's knowledge of pumps, Corning devised new methods of glass manufacture, even a new type of glass for certain parts.

And today chemical, food and beverage plants, and other industries handling corrosive solutions have a glass pump that works like a charm. Resistant to corrosion, it eliminates a cause of product contamination and undesirable chemical reactions. Resistant to heat shock, it may be cleaned with hot acids. Transparent, it permits constant visual inspection for cleanliness, color, sedimentation.

In the same way, Corning research for three quarters of a century has licked such glass problems as the bulb for Edison's first lamp, cooking ware for housewives, and tiny glass springs for chemical equipment. And in these days of metal-conservation, Corning ability has reached a new high in usefulness as engineers and production men use glass to solve their new problems. Industrial Division, Corning Glass Works, Corning, N. Y.





The Nash Glass Centrifugal Pump (left — cross section; above —coupled with driving motor, glass pump parts in background) can handle up to 6000 gal. of corrosive acids and chemical fluids per hour against a 65-ft. head.

CORNING
means
Research in Glass

TECHNOCRACKED . . .

By Edward C. Tudor
Senior in Electrical Engineering

•

Well, well, well,—To coin a phrase, here we are again, you lucky people. We missed the boat the first couple of issues, but then nobody was aware of our absence for this page was in other hands, so for spite dear readers we're going to ruin another otherwise good issue. The circulation will undoubtedly drop off, but so what, our advertisers are already hooked.

This business of priorities seems to have the country in an uproar. Just the other day we saw where the OPM was requisitioning Marlene Dietrich's legs to popularize cotton stockings.

However, we know of one lad who won't be bothered. Henry Ford has just announced the development of a car with a plastic body made from vegetable derivatives. This verifies a long standing suspicion of ours that a Ford was part automobile and part succotash. (Corny, isn't it? But then so's the auto.)

We're all for the idea, though. But we hope that we don't get another one of those engines made out of the iron extracted from mashed potatoes.

On second thought, the idea isn't so novel. It's just a case of reversing the process. Mr. Ford has been making plenty of government lettuce out of automobiles.

It looks as though we're in the transition period between the Age of Steel and the Age of Salad.

The principal ingredient of the car is the soy bean. It has been used for a number of products in recent years. This just goes to prove that any ambitious bean can get ahead.

With the present 26 per cent cut in automobile production it looks as though prices on this year's models will be marked "OPM Detroit."

The automobile factory has been turned into an arsenal. Maybe this season's new cars will have such names as the Blitzkreig Eight or the Blackout Special.

That is, provided there will be some new models to name. From the present outlook the 1942 Automobile Show will take place in an empty phone booth under a "No Loitering" sign. Maybe there's more truth than poetry to the old gag where the customer says "I would like to see a new car," and the salesman replies "So would I."

The unemployment situation will undoubtedly be keener, since we know of one contemporary wag who says that at least 50 per cent of American labor is employed in the business of thinking up dashboard gadgets.

World War II has taken on a new aspect. The latest British idea for increasing the dark circles under Der Fuerher's opulent optics involves a new unit of the army known as the Communicados.

To become one of the Communicados a man has to be a combination of Flash Gordon, Superman, and The Green Hornet. He has to be able to emulate a mountain goat, a ground hog, or a katydid at a minute's notice.

These lads spend their evenings roaming over the countryside of Occupied France engaged in such idyllic pastimes as strangling German sentries, blowing up bridges, and scaring h--l out of the whole German army. It's enough to drive the General Staff to drink; imagine the omnipresent fear of being the next one to get a hotfoot with a British hand grenade.

The regulation Communicado uniform is pitch black, and to carry out the color scheme they blacken their faces. Think of the mortification of a Shock Trooper who has been blitzkrieged by a traveling minstrel show.

The most effective part of this boogey-man barrage is the extreme silence with which the Communicados can get around. All of which brings strongly to mind the thought that one stands a pretty good chance of becoming something more than a reasonably exact facsimile of a ghost.

As "Bugs" Baer puts it: "When you figure what happened to Norway, France, Greece, Iran and points smaller, you can see a small country has its choice of entertaining a burglar or a sneak thief."

Gag of the Month: He—"Do you believe in life after death?" SHE—"No. But I believe in life before death—let's go!"

Heard at the last dance; "That's a nice dress you almost have on!"

NAMES IN THE NEWS . . . . . *(from page 12)*

been collecting guns since he was about ten years old. He now has a collection that he values at $500. Among his collection are two German pistols that are of particular interest and value. He has started the other boys in his house collecting guns, and they are always trying to trade him out of one of the German guns. He collects a few pipes and for further diversion enjoys aviation. He holds a pilot's license, and thinks that aviation is a lot of fun.

Kaptain Klean Says —

DO YOU MEN READ THIS PUBLICATION?
DO YOU READ THE ADDS?

If so, won't you cut this out and take it to the LAUNDRY DEPOT, 808 South 6th street and we'll give you a pencil—if you want to keep this magazine intact just drop in and ask for the pencil anyway and say "KAP I READ YOUR ADD IN THE TECHNOGRAPH!

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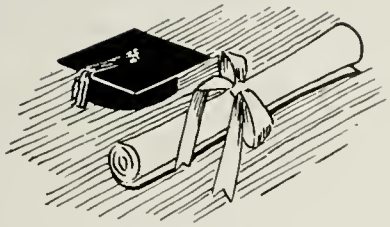

When the war is over, machinery of all kinds will be closely scrutinized for its ability to meet the changed conditions. Thousands of machines will be redesigned to give them higher speed, greater precision and lower operating costs in order that their users will be able to compete at a profit.

The greatly increased use of Timken Tapered Roller Bearings will be one of the most important factors in securing these results. In many machines—previously only partially Timken Equipped—Timken Bearing advantages will be extended to every rotating member. Many other machines will be given new and higher standards of performance through the use of Timken Bearings for the first time.

When you have gained a thorough understanding of Timken Bearings and their application you will be able to solve any bearing problem you may encounter and get 100% results. Begin to acquire that knowledge now; send for a free copy of the Timken Reference Manual.

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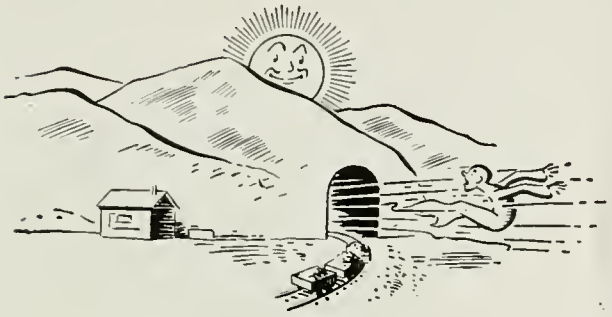
Manufacturers of Timken Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; Timken Alloy Steels and Carbon and Alloy Seamless Tubing; and Timken Rock Bits.

LOOK AHEAD!

After college--a world of severe competition. The more you know about Timken Bearings, the greater will be your success as an engineer.

G-E Campus News

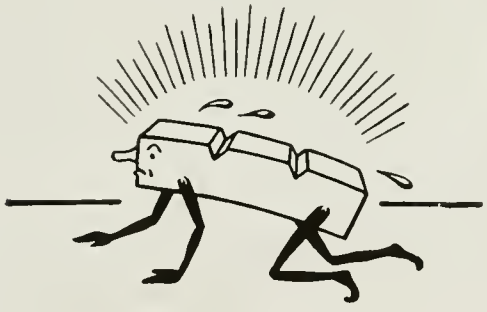


STEP ON THE GAS!

STEPPING on the gas to produce a speed increase of six feet per day along a highway wouldn't break any speed laws. But six feet extra per day makes engineers hang on their hats when the traveling is through solid rock. And that's the added progress being made by the company excavating the eastern portal of the new 13-mile Continental Divide tunnel by the installation of a new ventilating system utilizing G-E motors and control.

The system saves 20 minutes in the time between shooting each blast in the tunnel and getting back to drilling again. Fans spaced along the tunnel start up immediately after the blast, suck out the gas and smoke, and then reverse and blow fresh air into the tunnel. The fans start in sequence, with an interval of 20 seconds between each, so as to prevent building up large differences of pressure.

The tunnel is being excavated by the S. S. Magoffin Company, under the direction of the U. S. Bureau of Reclamation, to bring water for irrigation and power from Grand Lake, on the western slope of the Continental Divide, to the eastern slope.



CREEPY BUSINESS

STEEL, or any other solid material for that matter, deforms and creeps when subjected to heat and stress. But how much a given piece of steel in, say, a steam turbine, is going to creep during its life of 10 or 20 years is something a designing engineer can't wait 10 or 20 years to find out.

That's why all sorts of accelerated creep tests have been tried—ways to get a hurry-up prediction of the behavior of metal in service. Dr. Saul Dushman (U. of Toronto '04), assistant director of the G-E Research Laboratory, has thrown some new light on this problem by devising a method that produces extensions in length of as much as half a per cent an hour. By it he can get information in a day or two that would have required months by older methods.

The method consists of loading a thin wire of the metal with a weight, heating it with an electric current to a bright red heat in an atmosphere of nitrogen, and measuring the extension. The results seem also to suggest that creep does not occur atom by atom along the length, but rather in the movement of groups of atoms numbering from 50 to 1000.

95% PERFECT

MILADY will find her reflected charms brighter if her mirror is coated with silver, but that reflection will wear better if the coating is aluminum. That's what Frank Benford (U. of Michigan '10) and W. A. Ruggles, of the G-E Research Laboratory, found when they tested 37 kinds of mirror surfaces.

Silver evaporated onto the front surface of the mirror from an electric filament reflected 95 per cent of the incident light. The initial score for aluminum was only 88 per cent. But six months later the aluminum mirror was just as good as ever, while the silver one had deteriorated considerably.

Gold, incidentally, scored third among the pure metals, reflecting 82 per cent of the light. But while all the other metals gave their best results when evaporated on the front surface of the mirror, gold worked best when deposited on the back, as is the practice with ordinary looking glasses.

GENERAL ELECTRIC

963-30-M11

ILLINOIS TECHNOGRAPH

February
1942

★

Fatigue of Metals

Auto Transmission

Wind Tunnels

Better Highways

Names in the News

Technocracked

★

Left: Roads of tomorrow will be illuminated . . . see page 12. Lake Washington Bridge, Wash.

shed 1885 Member E.C.M.A.

20¢

Science Shoulders Arms

What science in the past has done for peacetime America needs no recounting.

But science today tackles a grimmer job. Research now must give America at war the fighting weapons she needs.

That's why Westinghouse Research Engineers—working in one of the world's leading laboratories—are devoting their full time to the nation's defense requirements.

We wish we could tell you about some of the remarkable things they've done already.

We shall—later.

Ever since its inception, Westinghouse has sought out and trained engineering talent, encouraged engineers to develop and work out new ideas, made itself an engineer's company. We're proud of the way our engineers have adapted themselves to creating and producing wartime equipment.

Westinghouse

"An Engineer's Company," Westinghouse Electric & Manufacturing Co., Pittsburgh, Pa.

FEBRUARY ★ 1942

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Published Eight Times Yearly by the Students of the College of Engineering, University of Illinois

Published eight times during the year (October, November, December, January, February, March, April, and May) by The Illini Publishing Company. Entered as second class matter, October 30, 1921, at the post office of Urbana, Illinois. Office 213 Engineering Hall, Urbana, Illinois. Subscriptions, $1.00 per year. Single copy 20 cents.

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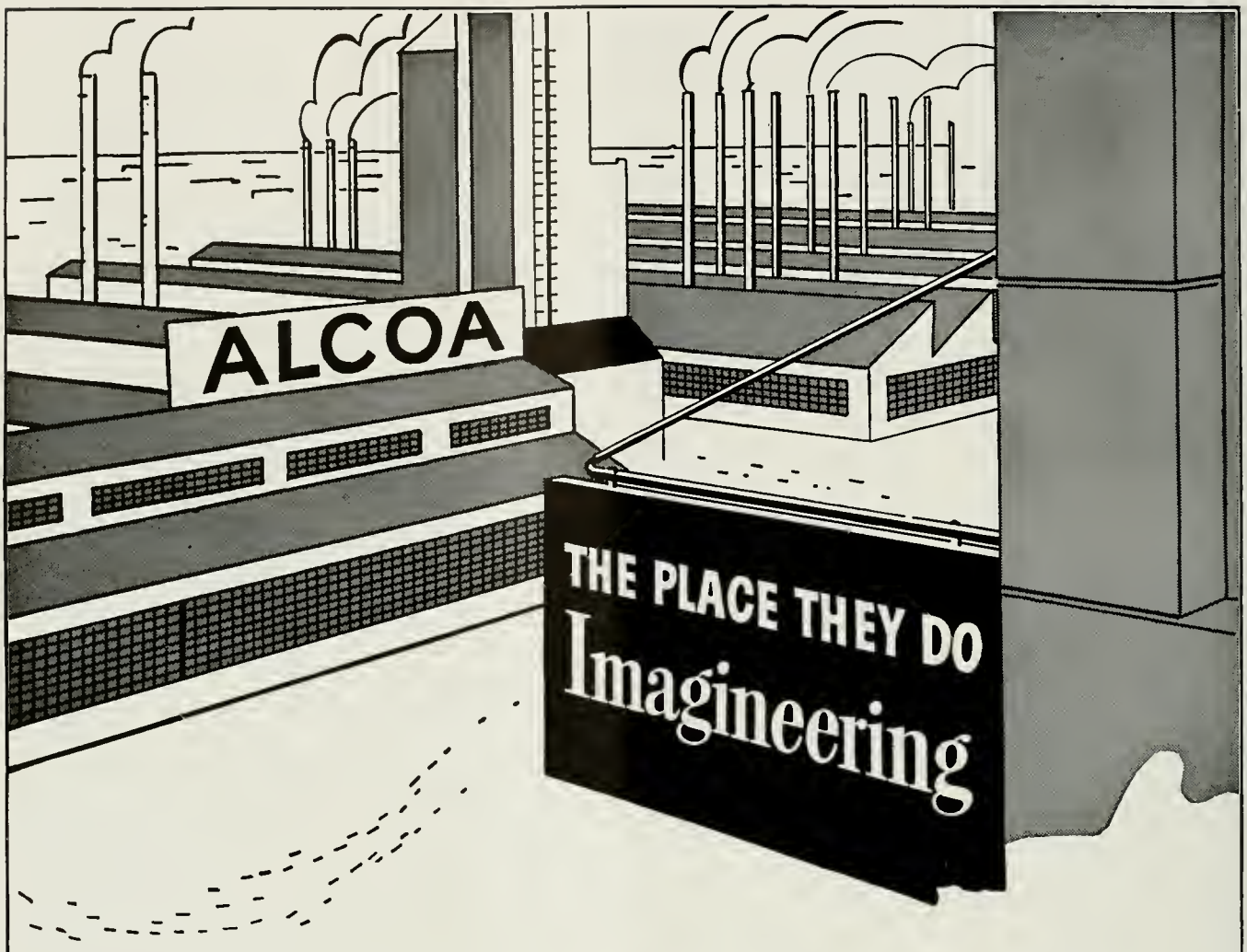

For a long time we've sought a word to describe what we all work at hard here at Alcoa.

It takes a very special word to describe making aluminum cheap, making it versatile, finding totally new places to use it, and then helping people use it where they should. In war times it takes a very special word indeed to describe, also, the ingenuity and daring that can make, almost overnight, three and four and five times as much aluminum as was ever made before, and make it cheaper than ever.

IMAGINEERING is the word. What aluminum did for civilians, what aluminum is doing for our armed forces, what aluminum will do in the future, all come out of that one word.

Imagineering is letting your imagination soar, and then engineering it down to earth. At Alcoa we have engineers with almost every kind of diploma, scientists with almost every "key" we know. Yet whatever career they follow with us, their real field is Imagineering. They work at it hard. They get results. The importance of aluminum is their own doing.

We at Alcoa would like nothing better than that our company be known everywhere as the place they do Imagineering.

ONE PAGE FROM THE AUTOBIOGRAPHY OF

ALCOA ALUMINUM

• This message is printed by Aluminum Company of America to help people to understand *what we do* and *what sort of men* make aluminum grow in usefulness.

Illinois Leads . . .
Fatigue of Metals
Investigations

By William G. Murphy
Junior in Civil Engineering

Repeated loading of steel plate is obtained in this fatigue test machine.

"When you lift one end of a walking stick, why does the other end come up?" That's a good $64 question asked by Sir Oliver Lodge, an English physicist. My money is safe since the answer to that question has been sought by research men since the middle of the 19th century.

During the first period of interest in the subject, the physicists would have given a definition of the reason by speaking vaguely of cohesion between the particles. Wohler and Bauschinger were the pioneers in a field opened by the advent of railroad rolling stock with "live" axles. The turning axle is subject to "fatigue" failure. By fatigue I mean the apparent wearing out of the property of metal which enables it to withstand the stresses and loads to which it is subjected—that property which the early physicists called cohesion.

The years 1870 to 1910 marked a "depression" period in the investigation of "fatigue" of metals, but some work was carried on at the Watertown Arsenal. Rudyard Kipling joined Tennyson and others as a scribe prophet during this period by an uncanny anticipation of the most modern theories in his story, "Bread Upon the Waters."

The development of the automobile and the increase in the use of metal about 1910 caused a revival in interest which did not catch the University of Illinois napping. In 1907, H. F. Moore, research professor in the Department of Theoretical and Applied Mechanics came to the school and his interest in the subject caused the purchase of the department's first "fatigue" testing machine.

The testing machines used today are direct descendants of the first machine used by Wohler which was a laboratory adaptation of the rotating loaded car axle. The Materials Testing Laboratory at the University of Illinois, which is recognized as one of the oustanding labs in this field, has about 50 machines for testing metals. Forty of these are general equipment and the rest are used for a special project of Professor W. M. Wilson's.

Early in the investigations several views were published which although they were wrong did a lot to stir up thought and show the need for further tests. A good point of the engineering reasoning is based on the principal that a theory may be used if the error is on the safe side, thus the early work provided a solid foundation on which to begin other experiments.

One of these early investigations advanced a theory of "crystallization" which states that under repeated stress the metal becomes brittle (crystallizes). It has been proved with the microscopic equipment now in use that it was not "crystallization," but a progessive fracture—a crack which spreads each time the load is applied. Many of you have split wood by making a crack and then forcing the axe through by repeating pounding on the ground.

Since 1910 much progress has been made. It has been established that sharp niches, notches, and even rough surfaces increases the possibility of a "fatigue" failure. One of the big contributions of this university was in proving that there is a limiting intensity of internal stress below which the metal will not fail no matter how often the load is applied. This took a large number of tests and a long period of time. The longest test at the University of Illinois laboratories applied a load at the rate of 1500 times per minute for over 400 days with the machinery running constantly.

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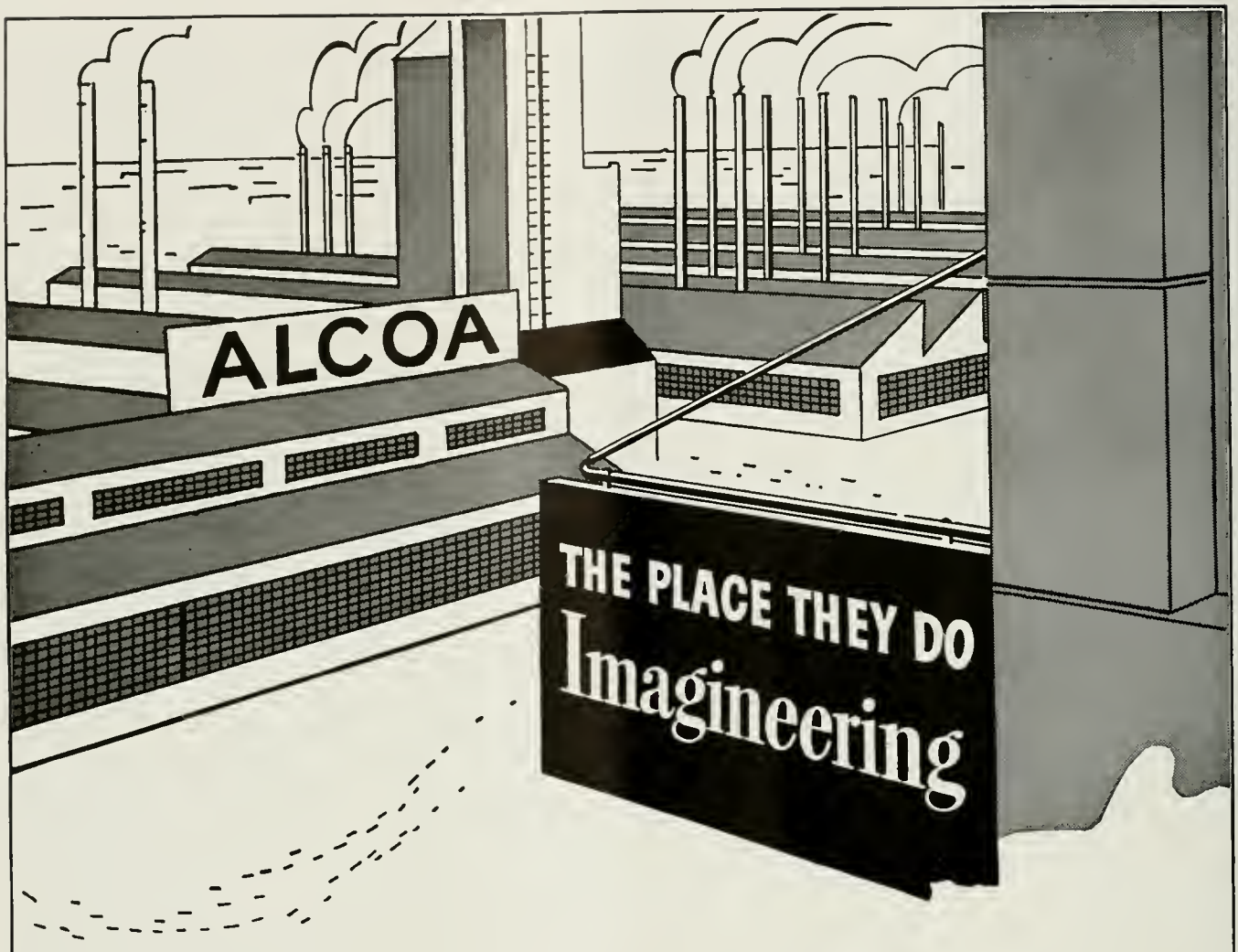
Illinois is most proud of the fact that men trained in the undergraduate and graduate schools are making a name for themselves in "fatigue" at the testing labs to which they go from here. Men in the Department of Theoretical and Applied Mechanics make investigations which are presented in the text material of the up-to-date books written by other members of the department. This is the infallible combination which is becoming the "Tinkers to Evers to Chance" of modern education.



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The Navy Department of The Bureau of Aeronautics is indebted to the men here for a big percentage of the investigations made to determine the cause of failure in the parts of airplanes. Moore, Lyon and Alleman made some tests on the time between the appearance of the crack and the final fracture; Moore and Henwood reported on the stress by the constant tension on screw threads; and Moore, Kommers, and Thomas found a great difference between polished and scratched surfaces in effect on the failure. One of the most interesting investigations reported was by T. J. Dolan on the amazing effect of corrosion fatigue when combined with stress concentration by a notch, hole or fillet.

There is an experiment now in progress on the fatigue strength of a specially developed alloy for aircraft. Prof. W. M. Wilson is studying the "fatigue" in welded and riveted structural members. Among the other investigations are a study of the damage done by punching on soft sheet steel and the effect of making sharp corners for wing ribs out of aluminum. The most outstanding fact in recent years

Illinois is most proud of the fact that men trained in the undergraduate and graduate schools are making a name for themselves in "fatigue" at the testing labs to which they go from here. Men in the Department of Theoretical and Applied Mechanics make investigations which are presented in the text material of the up-to-date books written by other members of the department. This is the infallible combination which is becoming the "Tinkers to Evers to Chance" of modern education.

Original Design . . .

NEW AUTOMATIC TRANSMISSION

By Tech's Dissatisfied Automotive Editor

By Robert E. McCleary
Junior in Mechanical Engineering

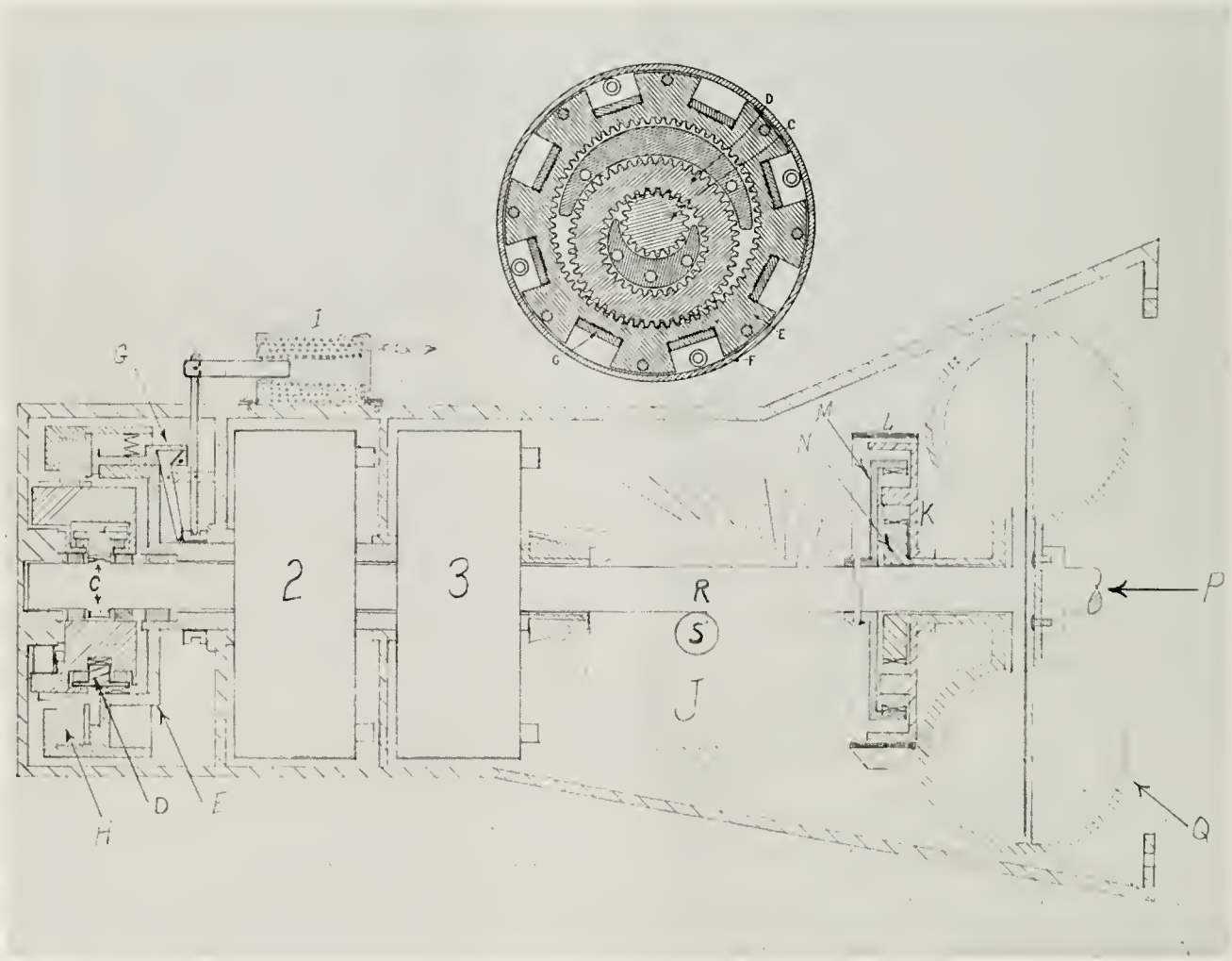
The placement of a gear reduction unit between the motor and wheels of an automobile is due to the shortcomings of the engine itself. The torque curve of an automotive engine starts from almost zero at idling speed and builds up to a maximum at from 1200 to 2000 R. P. M. Obviously, acceleration will be the greatest when the motor speed is in this vicinity.

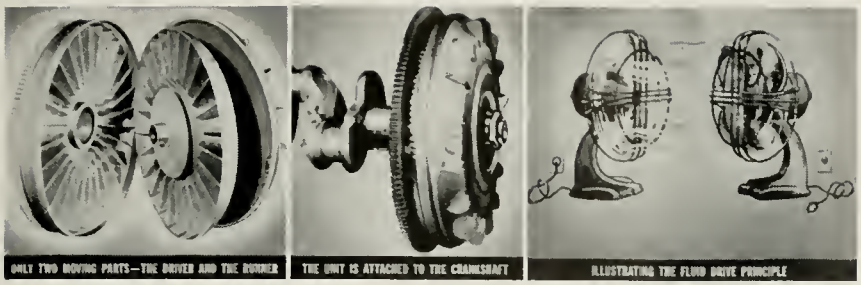
In the past a manually operated clutch and a 3-speed manually changed gear-box was fitted to almost all American cars. Lately the shifting range has been augmented by a 4th, and higher, automatic speed known as 'over-drive' for high speed driving, which results in better economy and less wear due to a slower turning motor. "Kickdown" overdrive makes it possible to drop from cruising gear to third (direct) by depressing the accelerator to the floor, for increased accelerations needed for passing and hill climbing.

Then came the fluid drive and its incorporation into automatic transmissions of great complexity, as seen in Olds Hydamatic drive. This system consists of an involved valve mechanism for controlling oil pressure from two separate pumps supplied to operate 4 band and disc clutches.

Chrysler uses a fluid drive unit and a four speed transmission with two ranges of two speeds each. Each range is shifted automatically by vacuum. The clutch is unnecessary in starting, but shifting from one range to another necessitates its use.

The complexity of General Motors Hydramatic automatic unit and the inadequacy of only two automatic shifts, even in conjunction with the fluid unit, of the Chrysler design has led the writer to design a transmission to suit his





ONLY TWO MOVING PARTS—THE DRIVER AND THE RUNNER | THE UNIT IS ATTACHED TO THE CRANKSHAFT | ILLUSTRATING THE FLUID DRIVE PRINCIPLE

own tastes of simiplicity, compactness, and flexibility.

This design is pictured as applied to a car of front wheel drive design, which design is based on sound engineering principles of power application. After all motor weight makes the front wheels more tractive. Having the front wheels pull the car around a corner instead of the back wheels tending to push the car off the road is obviously sensible practice.

The transmission shown incorporates a fluid drive unit, as in Chrysler, 3 automatic units as used in 1933 by Reo, a new 'kickdown' mechanism, and a new reversing mechanism. All shifting is done automatically and mechanically by centrifugal force, with the exception of the 'kickdown' mechanism which is operated by a simple electric solenoid coil. Drawings are diagramatic, only.

THE FLOW POWER

. . . is through the fluid unit Q from crankshaft to sun-gear C via solid shaft R. Sun-gear C drives internal-external gear D and consequently internal gear in drum E. Power then goes through a sleeve around main-shaft R to unit 2 for further reduction. From 2 to 3, power travels for further reduction prior to finally driving differential J through the hypoid gear on sleeve at right of 3. Power reaches wheels through R.

THE FLUID UNIT

. . . consists of two moving parts, the driver and runner. They are alike and are made of pressed steel. They resemble two halves of an eaten grapefruit with partitions remaining and core removed. The unit is about ¾ full of oil. The driver imparts motion to runner much like one electric fan imparts motion to another disconnected fan placed in front of it. The medium is oil not air, however. Actually, in operation, the driver causes the oil to move outward from hub, accelerating each particle from 44 ft. per second to 96 ft. per second at 1000 R. P. M. In the driven unit the runner decelerates each particle from 96 ft. per sec. to 44 ft per sec. Such a decceleration multiplied by the mass of the oil is the force which must be absorbed by the runner. It is this absorbed force which is transmitted to the wheels. At high speeds the oil takes the shape of a whirling smoke ring, being like a rotating and whirling torus ring.

Insufficient torque is generated at idling speeds to move the car. As speed increases, the slippage decreases from 100% at 0 M. P. H. to 5 per cent at 10 M. P. H., and to ¾ per cent at crusing speeds. Thus a slight depression of the accelerator causes a standing car to glide away, replacing the function of the clutch. This unit replaces the flywheel and has the starter ring gear on its periphery.

THE AUTOMATIC UNIT

. . . consists of a novel arrangement of gears and a centrifugally operated disc clutch. Gear reduction is accomplished by sun-gear C meshing with slightly larger internal teeth on gear D, whose external teeth engages main gear E, thus driving the directly connected sleeve on which the sun-gear of the next unit is mounted. Gear E is free to rotate about a center which is 5-8 inch from the center of the main shaft. This center is also free to rotate about the main shaft, an over-running clutch being incorporated which does not permit parts to move in opposite direction to incoming rotation. Main internal gear E is concentric with C.

Why Front Wheel Drive was Chosen

Front wheel driven cars have long been used in Europe. The Indianapolis 500 mile races have proven their stamina and ease of handling. The author has been particularly inspired by one of America's foremost financial plungers, E. L. Cord, who brought in 1935 a car of unique and prophetic design. It was the front-wheel drive Cord, a car of splendid performance, high speed, and fine riding qualities, engineered far ahead of its time.

As speed of E increases, the governor weights G near rim swing outward because of centrifugal force and exert pressure which smoothly engages multiple disc clutch, H. This causes the automatic unit to revolve with shaft R as a unit, reduction ceasing. Units 2 and 3 are identical with the one just described.

The forward (left) unit has an additional mechanism attached which allows governor weights G to be returned to their original position at any time, permitting this unit to reduce incoming power even at speeds which normally causes the clutch to be engaged. This produces the 'kickdown' effect so essential for quick accelerations. This is accomplished by a solenoid coil 1, drawing its armature inward, the resulting motion being transmitted through links and a shaft collar to a pin on weight G, which is depressed.

OPERATION

. . . From a standing start, the motor is speeded up by pressing accelerator. Torque is then sufficient to drive runner in fluid coupling and sun-gear C of left unit. Power then reaches wheels through units 1, 2, 3, all units reducing. This is 1st speed.

As speed reaches, say, 8 M. P. H., weights pivot outward and smoothly lock left unit in direct, reduction still taking place in 2 and 3. This is 2nd speed.

At about 15 M. P. H., the weights on 2 overcome a stronger spring and smoothly lock this unit in direct, giving 3rd speed.

At about 30 M. P. H., the weights in unit 3 lock this last unit in direct; all units are now locked in 4th speed and motion is from the fluid unit directly to the hypoid differential gear J, and thence to wheels.

At any speed above 8 M. P. H., the accelerator may be forced to the floor, closing a switch which causes solenoid 1 to operate, dropping the first unit into gear reduction once more.

All gear changing is smooth and without jerk or noise in these units, the oil immersed discs of the clutch engaging gradually. All weights return at proper time when speed is lowered.

The new non-automatic reverse is positive in operation, a foot pedal being used. With car stationary, foot pressure tightens band L, stopping drum K on which are mounted planetary gears which are turned by sun-gear N directly connected to the motor. Thus the power is transmitted to internal gear on drum M, which is bolted to shaft R, causing it to rotate oppositely to engine. Power does not travel through fluid unit. Actually, the runner now revolves in direction opposite to which the slapping oil tends to rotate it. However, at reversing speeds, this torque is slight and would be easily overcome by the positive drive through the band operated unit. In forward speeds, the band is off and the drum may rotate freely, allowing all power to pass thru fluid unit.

This transmission is believed by its author to be unsurpassed in simplicity, flexibility and compactness in the automatic field. The application is not limited to front wheel drives. Gear selection ranges may be altered for any set of speeds at will by increasing or decreasing spring pressure on respective governor weights.

CANNED HURRICANES

Speed Aerodynamic Design

By Robert E. McCleary
Junior in Mechanical Engineering

The Wind Tunnel and Models are Aviation's Laboratory and Guinea Pigs.

Millions of dollars are now being poured into aerodynamic research. Most of this capital goes into wind tunnels, which are more elaborate successors to the 22-inch square by 5-foot box in which the Wright Brothers placed models and fanned air through at 27 m.p.h., in 1903. From this first crude wind tunnel came facts for the construction of their first airplane to leave the ground.

Scale models of anything, skyscrapers, streamline trains, automobiles, transmission-line towers, bridges, and, of course, airplanes, can be easily made of wax or plasticine and placed in a wind tunnel for aerodynamic observation. These miniatures can be altered and re-tested in a few minutes time. In this article airplane testing only will be treated.

The basic principle of wind tunnels is that it makes no difference whether an object is moved through the still air, or is held stationary and air blown past it. The wind tunnel's purpose is to simulate the conditions of flight so that the dangerous and costly 'cut-and-try' process of altering full size planes and test-piloting them will be cut to a minimum.

Models are mounted on supports through which reactions in all directions are transmitted to a panel where they can be read directly from dials.

Two extremely important factors, the 'scale' effect (which physically represents the relationship between the inertia and viscosity forces acting on a body due to moving air) and the compressibility effect.

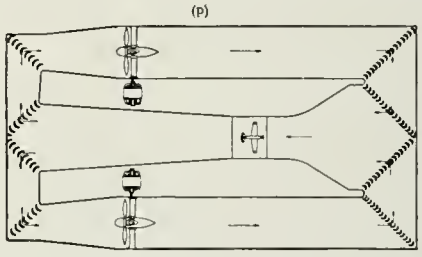
The first involves certain factors, and is measured by the Reynolds Number, i.e.,

$$RN = \frac{\textit{air density} \times \textit{air speed} \times \textit{length of object}}{\textit{viscosity of air}}$$

The extent of the effect of the second factor is represented by the March number, i. e.,

$$M = \textit{(speed of sound)} \; \textit{(air speed)}$$

In the compressibility phenomenon lies the reason for the oft-heard statement that 'man can never exceed the speed of sound.' Since air is compressible, any solid object moving through it sends ahead a convex-shaped pressure wave which prepares the air for the object's coming so it can divide and flow around it. Actually, sound itself has nothing to do with flight; sound is simply the physical effect of this same pressure wave, the speed of which sets the upper practical limit for flight speed. If the object 'runs ahead' of this 'warning-wave', the effect is to produce shock waves offering large resisting forces to passage. It is much like slapping the surface of the water broadside with a canoe paddle instead of pulling the paddle smoothly through.



Above: Double return tunnel layout above requires less overall length for same expansion of the air than the single closed return type, and less power than open end designs.

Above: Diagramatic drawing of Wright Field wind tunnel. Models are suspended upside-down and data is recorded automatically in a separate control beside the test chamber.

Though the speeds are still below 765 m.p.h., sound's speed, there are often eddy currents about certain parts of the plane which actually reach this speed. Propeller tips, air scoops, rivet heads, and cowling are main offenders.

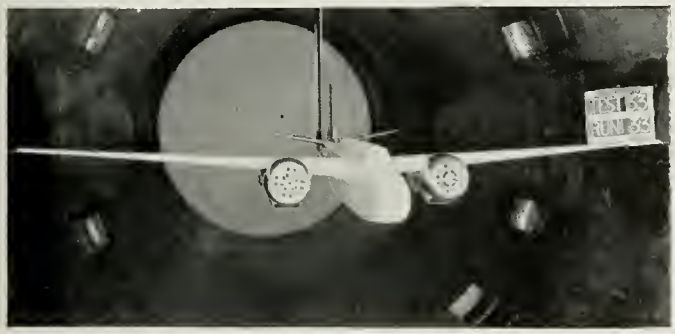
If model test data is to be strictly correct, the Reynolds Numbers must be equal. If the model is smaller than its flying counterpart, its RN is less. Obviously, to get equivalent Reynolds Numbers, the air speed and/or air density must be increased.

Actually, identical RN's are seldom achieved. However, at Langley field, a variable-density tunnel which can be pumped to 20 atmospheres has been built. The Wright Brothers tunnel at M.I.T., can be operated at a partial vacuum for high altitude simulation or at pressures up to four atmospheres.

A tunnel large enough to test full size planes would be desirable, but unpractical because of high power needed to produce wind velocities of today's pursuit ships. In Cha-

Right: 4,000-h.p. motors force an 118-m.p.h. wind past actual airplane in the N. A. C. A. full-scale tunnel at Langley Field. Air stream is 60x30 feet in cross section.

lais-Mendon, France, and at Langley field, Virginia, are the world's only tunnels large enough to test an actual pursuit ship. The one at Langley Field uses 8000 h.p. to create 118 m.p.h. of wind. It has a 60 x 30-foot cross-section. Power consumption of tunnels increases as the cube of the speed and the square of the crossectional area, thus making a 475 m.p.h. wind impractical, 512,000 h.p. being required for this tunnel.

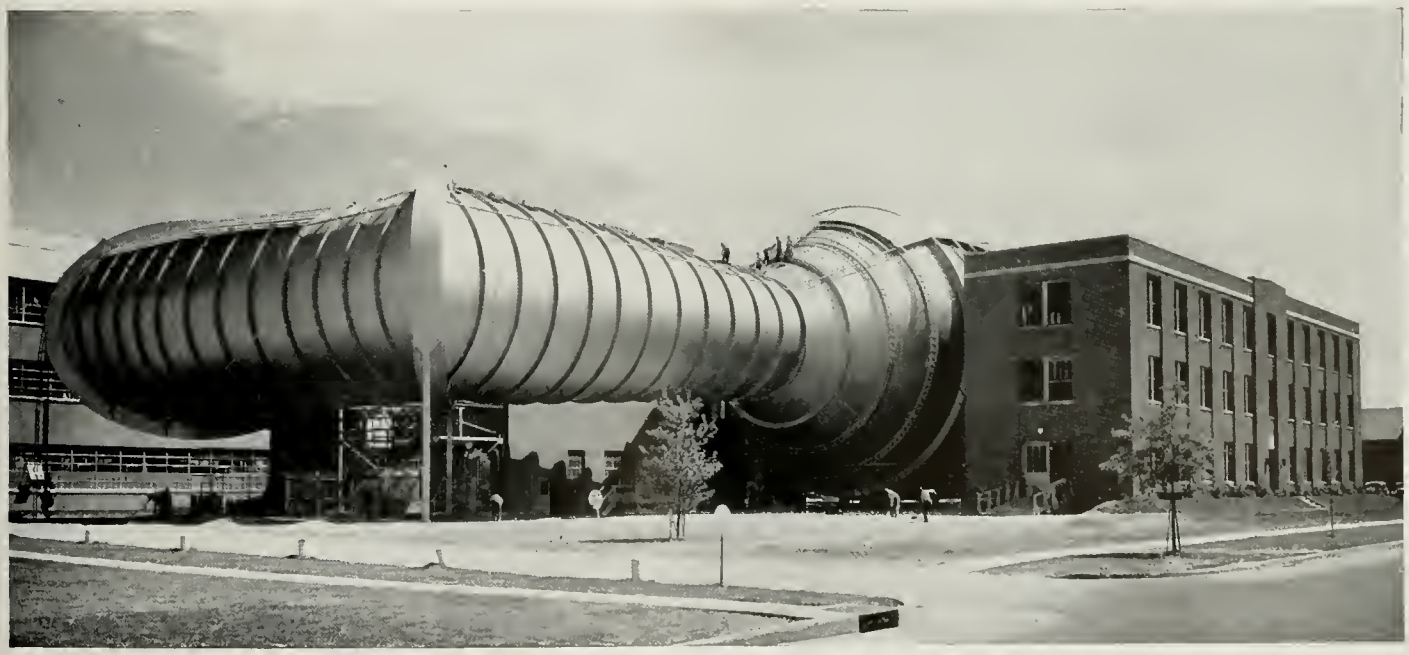


Above: Eight-foot model of a twin-engine bomber being studied for compressibility effects in the N. A. C. A. 500-m.p.h. wind tunnel.

Much valuable data can be obtained from tunnels of low Reynolds Numbers. Tunnels may be of the closed, continuous-circulation type, or open, where the air at atmospheric pressure is brought in from outside. No single tunnel provides all the answers, and many specialized types are in use.

Langley Field has no less than sixteen tunnels of various sizes and velocities. One produces a 500 m.p.h. wind in a section 8 feet wide. One is the full-scale tunnel already mentioned. Another is a vertical tunnel for tail-spin study. A 40,000 h.p. tunnel at Wright Field in Dayton, Ohio, will soon be completed. A 400 m.p.h., 20-foot wide current of air will be available to test models of 16-foot wingspread. A still larger tunnel is being built at N.A.C.A.'s Ames Laboratory, in California.

Certainly, aerodynamic research offers a big field to engineering graduates. While much is now being spent on military craft, the results will definitely be of great use in maintaining our national peacetime air superiority after the war.



Above: Wind tunnels have been called the world's largest precision instruments. This is the 19-foot variable-density tunnel at Langley Field.

Every Year Better HIGHWAYS . . . *Across America*

By Hayward L. Talley
Freshman in Electrical Engineering

TOMORROW

The building of roads began and progressed with civilization itself; historical notices remain sufficient to tell us brief stories of the road-building efforts of ancient Greece and of the Egyptians who took pride in their horses, chariots, and roads. To enlarge upon the history of ancient roads, we must then turn to a less ancient Roman Empire.

The roads of Rome were divided into two distinct classes, military and public. The methods of construction varied with the purpose. The military roads were in most cases sixty feet in width, of which space the elevated center occupied twenty feet. The public roads were often more remarkable for magnitude and breadth and for their straightness over surfaces of every kind than for smoothness or for general ease of travel. The roads were higher in the middle than on the side, and there were channels with small arches for carrying off the water. The roads were surfaced in one of three general ways, the general practibility determining which was used on each specific road: pebbles and gravel, flint-stones, and large flat stones laid with regularity. The latter is comparable to the brick streets of today.

Many striking examples of Roman skill in road designing and building still exist, the most outstanding being the great Appian Way, now well over two thousand years old. For many miles it seems to be in as perfect a condition as the day it was built. Roman roads spoke for themselves, and thus it came about that long after the fall of the Roman Empire, their proven methods of road construction continued to be used throughout Europe.

YESTERDAY

In America, during the early days of the English colonies, there was little need for roads. The settlers traveled by waterways or used the Indian trails which were suitable for a horse and rider or a pack train. In the latter part of the eighteenth century, the need began to arise for better lanes of transportation between settlements; as a result, private individuals cleared strips of timber and prepared narrow turnpike roads. These were very satisfactory in good weather, but gradually the need arose for a surfaced road suitable for year-around use. The United States Congress, soon becoming aware that ample lanes of transportation and communication were vital to the welfare of the young nation, began to make appropriations for road building, the various states usually carrying a larger part of the burden.

American road builders, having had little or no practical experience upon which to base their planning, began to use the English derivation of road-building used hundreds of years before by the Romans. Though our roads have been miracuously improved during the years of American road building, many of our highways today reflect the early Roman design.

With the advent of the automobile in 1892, travel speeds increased as rapidly as the roads would permit. In 1901 a trip was made by auto from Detroit to New York over a typical road in the record time of seven and one-half days. But that was in good weather. By 1904, there was only 144 miles of pavement considered to be adequate for all-weather use.

Probably the greatest stimulus to road improvement came with the passing by Congress of the Federal Aid Highway Act in 1916, previous to our entry into the first World War. During the following few years the need for well-constructed cross-country highways was seen as never before. Miles upon miles of hard-surfaced roads were constructed, linking together our many metropolitan areas. During the war these roads were given very grueling tests by our military vehicles. While a few seemed to meet requirements, on most others many faults were to be found. Pavements were as a rule far too narrow. Bridges were of an insufficient load capacity. Turns in the road were flat and square. In many cases the pavement itself failed to "stand up" due to a lack of knowledge concerning proper mixtures and reinforcements under various conditions.

Road building efforts previous to and during the first World War were designed to pull motor-transportation "out of the mud." In this respect the efforts were not fruitless.

Later efforts were concentrated on ironing out difficulties previously encountered, and thus prepared to meet the needs of a motoring public. Today the United States has one-third of the 9,000,000 miles of the world's highways, most of which is well-constructed two-lane pavement. Certainly under any ordinary situations our highways which together cover over 1,000,000,000 acres, would be adequate.

But ordinary circumstances do not exist. While we have 1/3 of the world's highways, we have four-fifths of the world's vehicles. Further, with each passing day additional burdens are placed on our roads by their increasing use by our military forces and defense industries.

During 1940 on the program of national defense there was designated a strategic network of military highways throughout the United States (known as the Pershing Map.) Various state highway departments were requested to prepare estimates of improving the highways and bridges up to a certain minimum standard, so that they could be used for quick movement of heavy army trucks as well as special equipment. Highway engineers predict that these circumstances will bring about a second new era of road construction.

Looking to the future we see a country which is rich in natural resources and natural beauty; a country whose engineering genius has provided for national security and defense without neglecting to design for its citizens comforts and luxuries of life such as the world has never known. Our cities will manifest the wonder and splendor of an age of invention and mechanics, our roads will be the super-highways of the motorists' dreams.

All bridges will be wide and magnificent in design. Grade separations will be provided at all intersections. All ditches will be closed. Our super-highway system will be well lighted. No telephone or power line poles will be seen, for all wires will be carried underground. The wide lanes of traffic will be divided by picturesquae green, shady

TODAY

parks, providing picnic areas, playgrounds, and comfort stations.

Yes, America, during the brief span of your national life you have wrought miracles of invention and discovery which have revolutionized the world and advanced civilization a thousand years in a single century. The vast wildness has melted away, and the new continent swings between the seas like a huge and beautiful hanging garden—the America of Tomorrow.

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NAMES

. . . *in the news*

By William R. Schmitz
Freshman in Chemical Engineering

BILL COONCE

Cadet Major Bill Coonce is one of the most active military men on the campus. He is commander of the Phalanx, member of Pershing Rifles, T.N.T., and A.S.M.E. He says that military is his first love, and wants to stay in the army for good.

Bill is a mechanical engineer and lists aero-dynamics and design work as his favorite subjects. He also found that Spanish was very worthwhile and has made it one of his interests. Other hobbies of Bill's are stamp collecting, model airplane building, swimming, and fencing.

As we said before, Bill's main thought is military. And one of the reasons that he chose Illinois as his school is because of the large R.O.T.C. unit here. Bill thinks that the quality of men in the R.O.T.C. is constantly improving because of the national defense. He says that he has gotten more out of military training than any other thing here at the university. He comments, "It is a big help to you, and tends to make you a leader in outside activities."

Bill thinks quite a bit about two military organizations here on the campus, Pershing Rifles and Phalanx. According to Bill, Pershing Rifles is the best military organization in the country. There is no parallel to that organization for the training of basic course students. Illinois has one of the largest units in the country. Phalanx, according to Bill, is "tops." Quoting from him, "We consider the boys in advanced R.O.T.C. the cream of those in military, and the boys in Phalanx are the cream of the cream."

FRANCIS WEIR

Hailing from St. Louis, Missouri, is Francis Weir, "sanitary engineer to be." Quite naturally he is thoroughly "wrapped up" in sanitary engineering. Francis stayed out of school several years and during this time he got some experience working at a water works plant. It was this work that really influenced his choice of profession.

After spending his first year at the University of Kansas, Francis transferred to Illinois. Admitting Kansas is a good school, he thinks its engineering school could compare in no way with Illinois. He did add, however, that Kansas had a very pretty campus, and was probably a little more democratic than Illinois.

The goal of Francis (and many of the rest of us) is to make a lot of money and then settle down and loaf in a nice comfortable home. In order to attain this, he expects to go into sanitary construction work, or possibly into public health or research work. Sanitary designing has especially appealed to him here at school. Incidentally, he thinks that it is a very good idea never to put off until tomorrow what you can do today. And he gives that reason for his scholastic average of 3.9.

BILL FRANCIS

Francis is vice-president of Mu San, honorary sanitary engineering fraternity. Yes sir, for a fellow who has gone through earthquakes, train wrecks and explosions, he is a very quiet mild mannered engineer.

JOHN LESSNER

That handsome chap with the appearance of Clark Gable is John Lessner. Most of the girls could go for John in a big way if he would let them, but he has a certain *one* back home at Shurtleff College in which he is quite interested. John lives at Alton, Illinois and so spent his first two years at Shurtleff, where he was on the varsity track and tennis teams.

John is a true sportsman, enjoying hunting, fishing, and all outdoor sports along with his hobby, photography. Nothing would please John better than some day to be able to become a retired sportsman. He would like to take an extended cruise on a sailboat and fish for days at a time if he so chose. He might be content to go to movies and to read. Beware, for his pet peeves are scatter-brained women and people who talk too much.

John is a member of Tau Beta Pi, Phi Kappa Phi, vice-president of Pi Tau Sigma, publicity chairman of A.S.M.E., M.I.D.A., and a member of the Mi-Hila ball committee.

Laboratory and machine shop courses have proved particularly interesting to John. He sports a very excellent scholastic average of 4.94. John has had several offers from different companies, but he believes that he will either go into research work for the Ethyl Gasoline company or take a position as test engineer for an airplane company at Hartford, Conn.

The objection that John raises to the mechanical engineering curriculum is that it needs modernization. He feels that text books should be brought up to date, and the courses presented in a more interesting way. At the present time John is doing a thesis on plastics under the direction of W. N. Finley of the T.A.M. department.

(*Please see page* 18)

JOHN CHARLES

Teaching a new Army old "tricks" in telephony

The telephone plays a vital role in army communications. So the Bell System is helping to school Signal Corps men in practically every phase of telephone construction, operation and maintenance.

This training job is but a small part of the tremendous task Bell System people are doing in this national crisis. They're setting up telephone systems for new camps, bases and factories — handling an enormous volume of calls needed to coordinate the Nation's war effort.

Throughout the country, Bell System people are wholeheartedly cooperating in the drive for victory. To men and women of their high caliber, there is real satisfaction in a difficult job well done.

AMERICAN TELEPHONE & TELEGRAPH CO. AND ASSOCIATED COMPANIES — BELL SYSTEM

TECHNOCRACKED . . .

By Edward C. Tudor
Senior in Electrical Engineering

•

We understand that a recent F. B. I. investigation disclosed that ten per cent of the population earns its money by criminal pursuits. Obviously this doesn't include gag writers.

We were at a loss for material this month, but a glance at the headlines reminded us that Italy still professes to be at war with the Allies. For example one headline was: Mussolini Discusses War with His Generals. They must have been reading about it. No longer need Il Duce urge Italians to "live dangerously." The British are taking care of that.

It looks as though we will have to make tanks to whip the Germans, planes to use on Japan, and a repeating pea-shooter to annihilate the spaghetti eaters.

Then there's the pigeon who was sunning himself on the Tower of London when a friend flew by. "Hello Bill," he said, "How are you." "I'm fine," said the first pigeon, "but my brother is all tired." "What's he been doing," asked the friend. "Well," answered the first, "he took a little flight over Libya last week . . . and before he knew where he was, he had brought down twelve Italian planes, single-handed."

They tells us that beyond the Alps lies Italy. So what? Beyond the billboard, lies America.

Churchill on his visit to America apparently has an Axis to grind. He is quoted as saying that co-operation between Great Britain and Russia is as close as "geographical and other conditions allow." "Other conditions" couldn't mean the German army, could they, Mr. Churchill?

News item—"British forces fall back." This is where we came in on the first feature.

War has some blessings, anyway, for so great is the demand for steel the number in new shirts will have to be reduced.

One of the air raid instructions needs no emphasis for College students. It says, "Get under a heavy table." If this is all that's necessary, an air attack New Year's Eve would be a total failure. If accompanied by a blackout, the country would look like prohibition was here to stay. People will enter a bomb-shelter by knocking twice and furtively whispering, "Joe sent me."

Our private solution of the Japanese situation:—One thousand AFL workers placed on a Pacific isle would stop the Japs cold with a jurisdictional dispute.

Insurance statistics tell us, "People 70 can expect to live nine more years." Those between 18 and 44 cannot all have the same expectancy.

"Germany has no desire to injure her friends," say the *Berlin Angriff*. As a matter of fact, Germany can shoot in almost every direction without fear of hitting friends.

Morgenthau says the United States must feed the people of Europe. Well, there are fewer of them every day.

"The food resources of America set world record."—*St. Louis Star-Times*. Now, if they will just price it so we can buy it, we'll eat it.

California announces they produce 50 per cent of the lemons. The other 50 per cent must be voluntary residents.

Another headline:—"Record Amount of Water Used Here." Somebody must be drinking the stuff.

And another:—"Boy's Throat Coughs Up Single Nickel." Try again, Doc; you might hit the jackpot.

We see where Harvard has a course in ditch digging. They'll be giving WPA degrees next. Queer things happen at institutions of higher learning. For example there's the wire-haired terrier that has been enrolled as a student at Syracuse University for three years. We know a few professors who should be registered with the American Kennel Association.

We were asked the other day if you can call an ex-sorority girl a fugitive from a Jane gang. It wouldn't be the healthiest thing one could think of.

Then there's the Engineering Assistant who couldn't afford to play golf, so he threw an aspirin tablet on the front lawn and spent the afternoon looking for it.

Norman Bel Geddes predicts the automobile of the future will have a 150-inch wheelbase. The width will undoubtedly remain the same as that of a prostrate pedestrian.

Now they have an airplane that flies with no human intelligence to guide it. Heretofore, only automobiles made a practice of it.

If history repeats itself the American taxpayer would do well to take heed to the story of Percy Lister, member of the British Purchasing Commission.

In 1937, he and associates purchased an established business then running in the red. Under new management it prospered; last year showed a profit of $1,500,000. But the owners didn't get a nickel; in fact, owed the gov't money. Here's why:—

On the $1,500,000 profit the tax was 50%—$750,000. In addition, where profits are over $1,000,000, the gov't takes 100% of the first $1,000,000. That made the tax, according to gov't figures, $1,750,000. The owners protested that they had made only $1,500,000.

"That's quite all right" said the tax official. The gov't has made provision for such cases. We will take a mortgage on your plant, and lend you the $250,000 necessary to pay your tax." Quick, Jeves, my slipstick!

We surrender to the printer with this parting shot:—If nobody quit high school who would there be to hire college graduates?

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THE DEVELOPMENT and production of synthetic aromatic chemicals is a division of Dow's activities that is rapidly growing and constantly revealing new market possibilities. They are chemicals necessary for the creation of both fragrance and flavor in a wide variety of products.

The delightful fragrances of the rose, the gardenia and the orange blossom are being recreated with the aid of an ever increasing number of perfume bases. Tobacco, chewing gum, soft drinks and a host of other well-known everyday products likewise benefit through the accentuation of their flavor characteristics by Dow aromatic chemicals.

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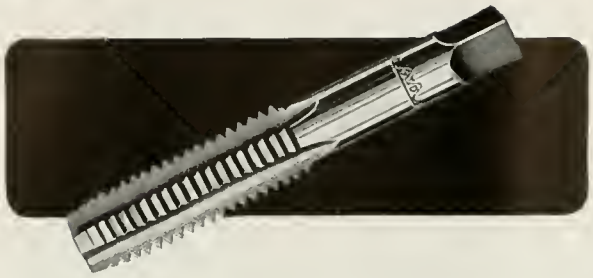

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NAMES in the NEWS

. . . *from page* 14

CHARLES NEAS

The man you see behind all those test tubes, retorts, and other chemical apparatus is none other than our friend Charles Neas. He comes to Illinois from the deep South, claiming Johnson City, Tennessee as his home town. Since Tennessee State is located at Johnson City, Charles spent his first two years there before transferring to Illinois. At Tennessee State Charles was on the debating team, but since coming to Illinois he has not had extra time to spend in outside activities.

Urging that chemical engineering be transferred from L.A.S. to the College of Engineering, Chuck also thinks too much emphasis is placed on grades.

Charles is a member of Sigma Tau, Tau Beta Pi, and American Institute of Chemical Engineers. Since he is a chemical engineer, Charles explains he doesn't find much time for hobbies or social life, and he confined most of his entertainment to the current "flickers" in various theaters.

Having a fine 4.897 average, Charles is allowed to do some research this year. At the present time he is working on a method of liquid extraction in which a continuous flow of liquid is kept in several tubes and the extraction depends on the character of the molecules instead of the size of the molecules. Of course no one but a chemical engineer will understand this process but it sounds interesting.

Charles is looking forward to getting a fellowship at M. I. T. There he intends to do some research and developing, but he doesn't know for sure whether or not he will continue his work on continuous liquid extraction.

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THE SECOND DISCOVERY OF AMERICA

In America, science is discovering a vast new world—a tupendous world that Columbus never dreamed of. This iew America is boundless. Its riches are infinite, thanks in arge measure to the magic of *synthetic organic chemistry*.

One of the discoveries in this field is an amazing series of ynthetic plastics—"Vinylite" resins.

In one form or another, these astounding materials appear n such diverse essentials as food-can linings . . . and tank-car inings; as airplane cockpit covers . . . and non-flammable in-ulation for vital electrical wiring; as corrosion-resistant rrappings for cross-continental pipe lines . . . and welders' oggles; as the thin film on paper which is put inside bottle aps . . . and as the invisible interlayer in the sandwich of afety glass.

"Vinylite" resins can be formed, drawn, laminated, and bonded. n basic form, they are odorless, tasteless, and non-toxic, and range from on-flammable to slow-burning. They can be made stiff or flexible . . . ard or soft . . . colorless or almost any color under the sun . . . trans-arent, translucent, or opaque. And the result is resistant to oxidation . . . aterproof . . . alcohol-, alkali-, and acid-resistant.

These unusual properties have created a heavy demand for "Vinylite" resins, particularly to meet defense needs. This is why it is not possible, at present, to supply all manufacturers of articles for personal and home use with all the "Vinylite" resins needed. Against the return of more normal times, when larger quantities for normal uses will again be available, manufacturers are invited to test these new plastics . . . to develop new and improved things to be made from them . . . so that all can benefit from the discovery of "Vinylite" resins.

• • •

"Vinylite" resins and plastics are supplemented by the well-known products of Bakelite Corporation. The resins themselves are produced by Carbide and Carbon Chemicals Corporation. Certain elastic sheetings and films are made from these resins and marketed by National Carbon Company, Inc., under the trade-mark "Krene," while other compounded forms useful in electrical insulation are marketed by Halowax Corporation. The manufacture of all these products has been greatly facilitated by the metallurgical experience of Electro Metallurgical Company and Haynes Stellite Company and by the metal-fabricating knowledge of The Linde Air Products Company. All of these companies are Units of Union Carbide and Carbon Corporation.

CARBIDE AND CARBON CHEMICALS CORPORATION

Unit of Union Carbide and Carbon Corporation

30 East 42nd Street UCC *New York, N. Y.*

Producers of Synthetic Organic Chemicals

HEIGHTS of CLOUDS

Measured With

MERCURY LAMP

A tiny, 1,000-watt mercury lamp developed by General Electric for searchlights and television studios has been used to solve a vital problem of aviation—the daylight measurement of the height from the ground of clouds.

Maurice K. Laufer and Laurence K. Foskett of the National Bureau of Standards discovered that by projecting the light from one of the high intensity water-cooled quartz mercury lamps, and noting with a photoelectric eye the "splatter" of the light where it hits the cloud, that the altitude can be calculated by triangulation.

"During the daytime," they explain in the Journal of Research of the National Bureau of Standards, "dark overcast clouds at an elevation of 9,000 feet have been readily detected. For cumulus clouds illuminated by direct sunlight and having elevations up to 4,000 feet, the detection is positive."

The projector consists of the lamp located at the focus of a 24-inch parabolic mirror having a 10-inch focal length. The "electric eye" detector consists of a vacuum-type phototube placed immediately behind a diaphragm with a slit opening 3 25 by 11 16 inch located at the focus of an eight-inch plano-convex condensing lens.

The narrow beam from the 1,000-watt lamp is projected into the sky at a frequency of 120 flashes per second and the rays scatter when they hit the clouds. This light scattering is detected by the photoelectric eye located at a known distance from the lamp and adjusted for this flash frequency that will distinguish the beam from background atmospheric light.

The cloud height then is determined by the solution of the right triangle formed by the line of the beam to the clouds, the angle of the electric eye sight upon the clouds and the base line connecting the beam projector and the phototube.

The Bureau of Standards scientists developed the method at the request of the United States Weather Bureau which at present employs small helium-filled captive balloons for the job. The balloons are reeled out like kites and observed through optical instruments. When the balloon disappears into the cloud, its height is estimated by the length of played-out line.

Sometimes these balloons are equipped with instruments for recording the temperature, pressure, and humidity at various altitudes. From these readings, cloud heights are calculated upon the basis of previous records and the result checked against the visual observation.

The quartz water-cooled lamps are the outgrowth of the search for a small light source of high brightness and efficiency and are possible because the industry now has available new glasses and sealing technique for quartz bulbs. The 1,000-watt lamps have been available commercially in this country for about three years. Single lamps of this type were used in the 16 searchlights whose beams crossed the Court of Peace in the New York World's Fair.

Doctor (after examining patient): "I don't like the looks of your husband, Mrs. Brown."

Mrs. Brown: "I don't either, Doctor, but he's good to the children."

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How to Slice a Meteorite!

Ever see a shooting star? There are about 7,500,000 every night! Most of them burn up in the outer atmosphere, and the few that reach the earth are man's only material link with celestial space. For examination and study, these hard, dense meteorites are easily sliced with a special type of bandsaw using Carborundum Brand Abrasive Grain as cutting agent, then finished with finer grain and powders.

Interesting, too, are the many industrial uses for Carborundum-made abrasive grains. They help polish and finish countless products, from cutlery to plowshares, from the bevelling of glass to the lapping of transmission gears and the grinding of optical lenses.

Whatever may be the use of grinding wheels, coated abrasives and other abrasive products in the industry you enter, you'll find our outstanding research, manufacturing and engineering facilities can render a real service. Write The Carborundum Company, Niagara Falls, New York.

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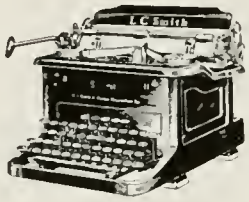

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Saved Until Last

He was one of those persons one does not often meet at parties, and luckily, but there he stood, with his great white beard and commanding brow, looking triumphantly over the young faces about him. "I'm seventy-eight years old," he declared proudly, "and never tasted strong liquor, used vile language, or indulged in the excesses of smoking in any form. What is more, I have worked harder than any man I have ever known."

A young man near him sighed, "What a tragedy!"

"Tragedy!" exclaimed the octegenarian.

"Yes, tragedy," replied the young cynic. "I can understand your not drinking, your refraining from smoking, and your distaste for wild women and vile language, but what in hell did you work for?

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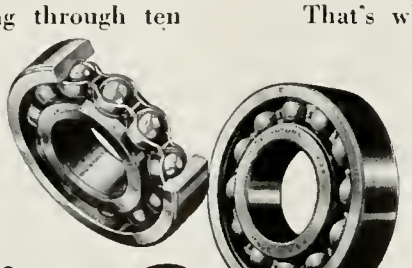
● Our "guest artist," Dr. Seuss, has caricatured the remarkable machine which digs ditches for pipe lines or for Army trenches.

This machine is shown operating through ten inches of frost. In it, 67 New Departure ball bearings, many of them self-sealed to keep dirt out and lubricant in, assure long life, maximum power for digging and extremely low maintenance.



Since war is now highly mechanized, all vital moving parts of these machines must revolve or reciprocate on anti-friction bearings.

That's why New Departure is concentrating its great manufacturing facilities, the greatest ball bearing plant in the world, *all-out for defense!*

New Departure, a division of General Motors, Bristol, Connecticut. Detroit, Chicago, San Francisco, Los Angeles.

New Departure

THE FORGED STEEL BEARING

3059

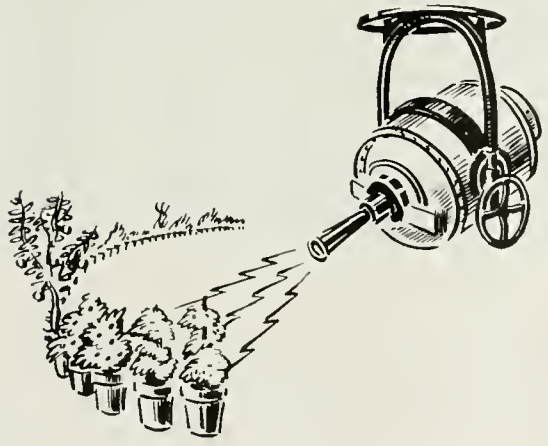
G-E Campus News

UNDER ONE ROOF

THE General Electric Company has a leased-wire communication system which functions as smoothly as if all G-E branches were housed in a single building.

During the year 1941, a total of 3796 miles was added to the leased-wire communication system to help speed the handling of contracts. A network of 11,565 miles is now available for telephone and teletype messages.

The telephone network covers 5630 miles and serves 17 key industrial cities in the East and Middle West. It contains 37 individual wires, many of which can be interconnected for greater flexibility and coverage. The teletype network comprises 4822 miles of full-time circuits and 1113 miles of part-time circuits. Thirty-one cities are served directly, and many others are served indirectly.



VOLTS AND VITAMINS

THE General Electric industrial X-ray laboratory recently moved a large number of apple and other fruit trees, berry bushes, and tomato and string bean seeds into the confines of its workrooms.

There, under an X-ray machine, these various specimens of flora were bombarded with 1,000,000-volt X rays. They were then returned to the New York State Experiment Station at Geneva for planting and subsequent observation of the effect of the X rays upon the color, size, flavor, quality, resistance to disease, and other characteristics of the fruit and vegetables.

Variations and mutations are to be expected when living plant cells are subjected to bombardment with X rays. Under forced germination, effects of the 1,000,000-volt treatment on seeds may be observed within a few days, but, for the young trees and berry bushes, the full effect will not be known for at least five years.

LE DERNIER CRI

THE General Electric Company's construction of the first large electric plant in the Belgian Congo was stalled by the lack of dowel pins, the only items missing from an inventory of hundreds of parts. The whole camp was searched, natives were questioned, but not a single dowel pin was found.

With a 90-day deadline, replacements were out of the question, so, with makeshift materials, tools, and help, new dowel pins were fashioned. The job was finished on schedule.

Months afterwards a visitor to a half-savage tribe in the Belgian Congo found men and women alike wearing a new type of nose ornament. Thrust through the cartilage of the nose, gleaming and twinkling in the African sunlight, the missing dowel pins were the pride of the natives.

GENERAL ELECTRIC

963-32-211

ILLINOIS TECHNOGRAPH

MARCH
1942

★

Strategic Metal

Submarines

EE Show 1942

Betatron Research

Fluorescent Lighting

Names in the News

★

Left: Oil circuit breakers and transformers at Boulder Dam Power Plant exemplify electrical engineering progress.

shed 1885 Member E.C.M.A.

20¢

The heat treatment that contradicted itself

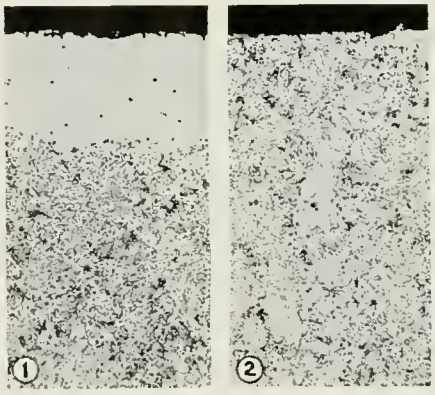
How Westinghouse Engineers straightened out a paradox in steel

METALLURGISTS have been heat-treating steel for 2,500 years. They've taken steel parts, subjected them to heat, cooled them quickly by quenching them in water, oil, or gas, and so hardened them.

But the heat treatment contradicted itself.

For while they were heat-treating the steel to harden it . . . they also softened it. As the steel was being heat-treated, oxygen combined with the surface carbon, decarburized and softened the surface.

Naturally, metallurgists had to remove this softened surface. They had to pickle, grind, or machine the surface—processes



This photomicrograph of SAE-6150 Spring Steel shows .005" decarburization with ordinary scale-free atmosphere.

This photomicrograph of SAE-6150 Spring Steel shows no decarburization with Endogas atmosphere.

which not only wasted time and cost money but also accounted for a whole lot of inefficiency.

The dimensions of many steel parts, especially dies, have to be accurate to a few thousandths of an inch. So, metallurgists had to make the steel parts larger to start with, just enough larger so that they'd be the right size after the softened surface had been removed. And that left room for plenty of mistakes.

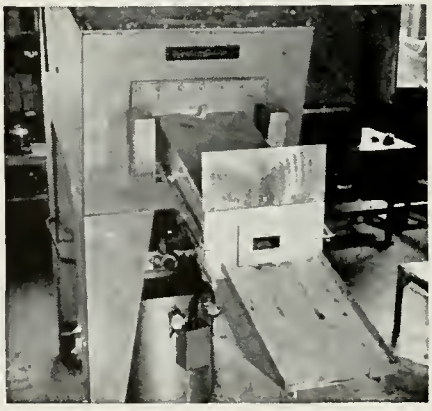
▸ Something, Westinghouse engineers decided, should be done to get rid of all this heat-treating trouble.

They figured the thing to do was to find a way to keep carbon-hungry oxygen from getting at the steel surface. And that was the thing they did.

First, they settled on using an electric furnace since it would give them accurate temperature control and entirely eliminate gas fumes. Then, they created a special atmosphere for the furnace. They heated ammonia (NH_3) in the presence of a catalyst and separated it into its component parts, nitrogen and hydrogen. The nitrogen is inert and won't combine with anything. The hydrogen, in the absence of oxygen and water vapor, also refuses to have anything to do with the carbon.

In this special atmosphere, which Westinghouse engineers called Ammogas, steel parts could be treated with electric heat and . . . no softening of the outer surface took place, no time-wasting, inefficient finishing had to be done. The dies and other steel parts came out of their heat treatment bright, shiny, all ready to use.

▸ The Ammogas furnace that Westinghouse engineers created took care of the heat-treating of costly parts like dies, which can be gas-hardened and are not produced in great quantities. But Ammogas is expensive—too expensive for



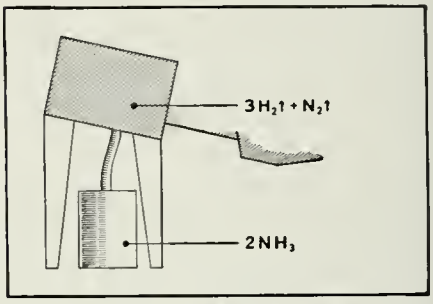
Here is an Ammogas Furnace.

the ordinary heat-treating of thousands of machine parts. And it is not suitable for heat-treatments requiring high temperatures.

So Westinghouse engineers developed Endogas—a special atmosphere which would do large-quantity, high-temperature heat-treating jobs, and do them at low cost. They heated ordinary gas (natural or manufactured city gas is all right) and, by a special but inexpensive process, changed it into a gas rich in hydrogen and carbon monoxide and containing a little water vapor and carbon dioxide.

Endogas doesn't do its work by *avoiding* all decarburizing agents, carbon dioxide and water vapor; it *overpowers* them by the inclusion of agents like carbon monoxide and methane that work in the opposite direction.

In effect, Endogas maintains a balance between carburizing and decarburizing forces. This balance can be so closely controlled that it is even possible to *add*



A diagram of the Ammogas furnace.

carbon to the steel that's being heat-treated.

Today, the Ammogas and Endogas furnaces are hard at work heat-treating dies, castings, airplane parts, steel parts of all kinds, helping to turn them out faster and better—saving industry time, money, and mistakes—speeding crucial war production.

★ ★ ★

There is one reason why Westinghouse was able to create controlled atmosphere furnaces and lick decarburization. It is because Westinghouse is an engineer's company.

There are 3,500 engineers in Westinghouse . . . in service, in sales, in design, in research, in management, in every branch of the business. Engineers hold key positions in each of the 17 Divisions of the Westinghouse Company.

Engineers determine our ability to find better ways to get jobs done. Engineers direct the creation and manufacture of our products. Upon engineers our success depends.

Behind our training and our encouragement of individual effort, there is a definite purpose. Behind our organization set-up of many divisions, which are like small companies within a company, there is a definite purpose. That purpose is to develop young engineers like you into the kind of engineers who will take good care of our future.

Westinghouse

"An Engineer's Company," Westinghouse Electric & Manufacturing Co., Pittsburgh, Pa.

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MARCH ★ 1942

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Published Eight Times Yearly by the Students of the College of Engineering, University of Illinois

Published eight times during the year (October, November, December, January, February, March, April, and May) by The Illini Publishing Company. Entered as second class matter, October 30, 1921, at the post office of Urbana, Illinois. Office 213 Engineering Hall, Urbana, Illinois. Subscriptions, $1.00 per year. Single copy 20 cents.

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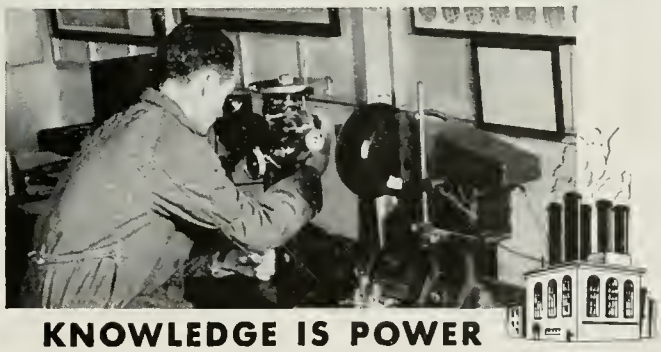

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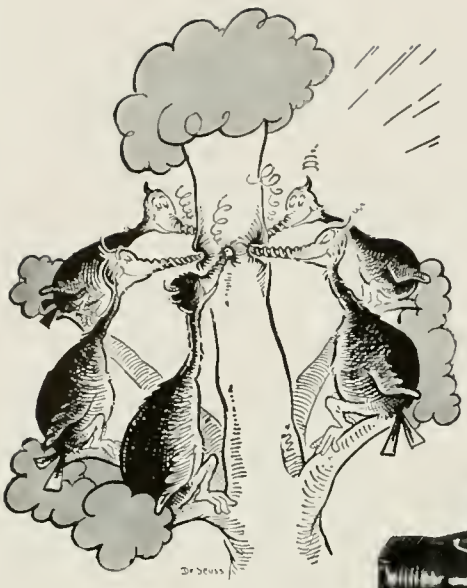
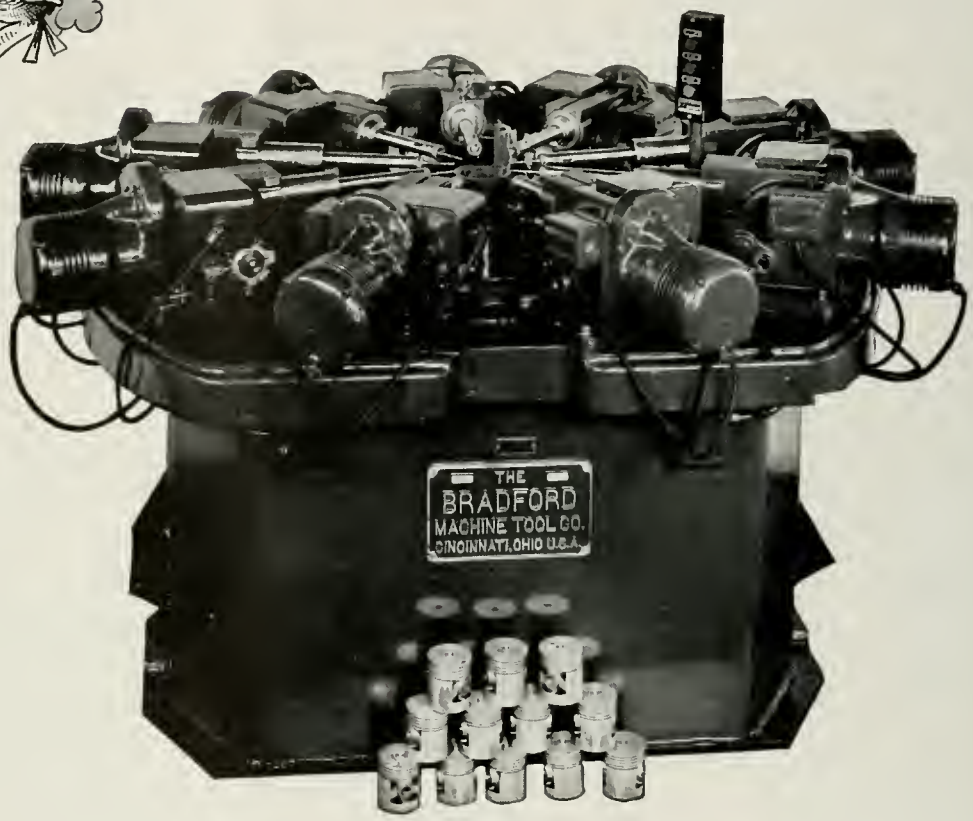


The Sapjap Calls It Heaven

He sits all day, drilling the beautiful wood. He has lots of time. Holes won't be spaced right, but he doesn't care. He thinks it's champagne—the sap.

How different his neighbor below. It has work to do—fast, accurate, continuous work. 10,800 holes per hour, 14,400 pistons per day. No time to adjust or fuss with bearings.



America Demands Speed . . .

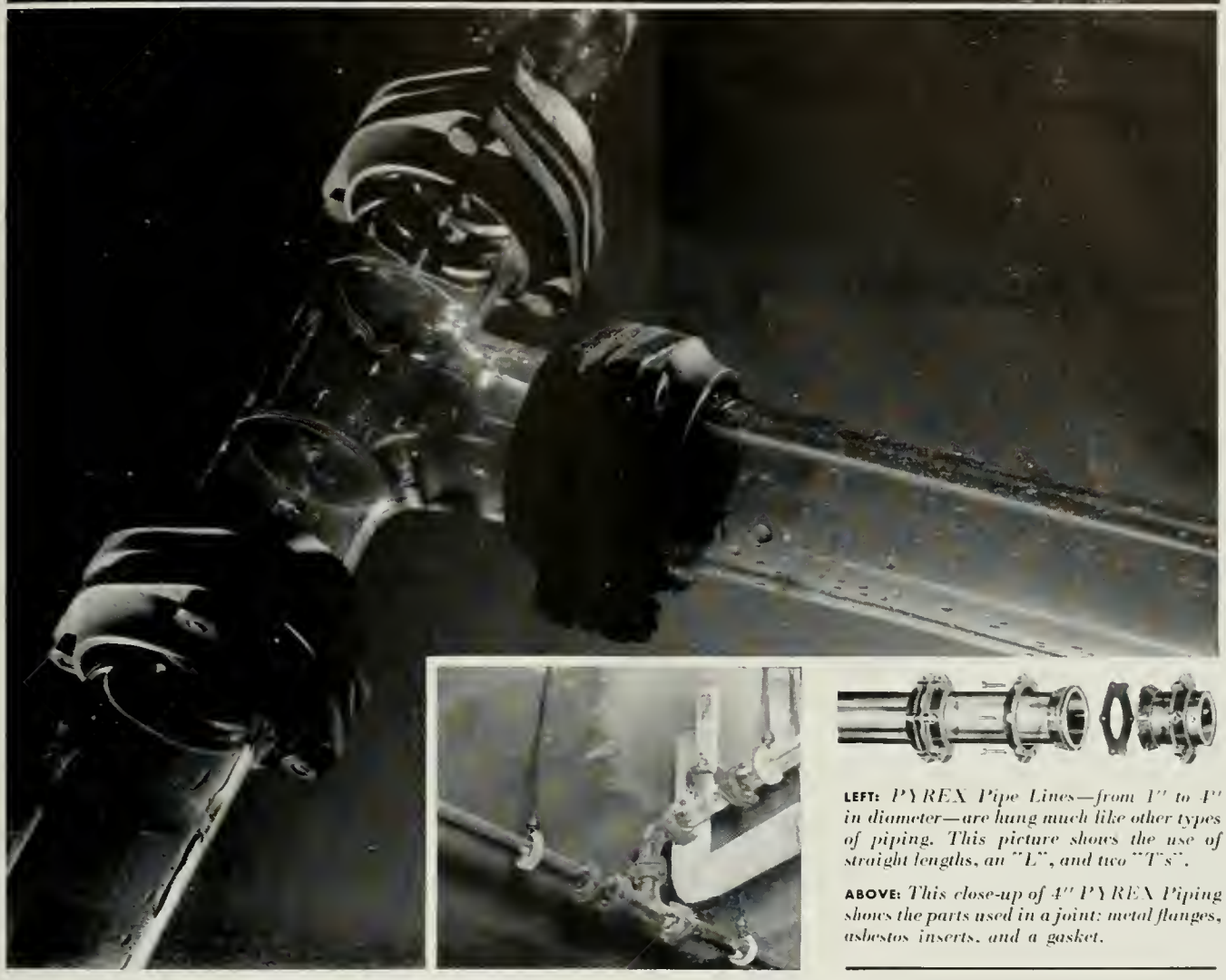
and gets it in this 9-spindle Bradford Drilling Machine. 92 New Departure ball bearings support its rapid fire spindles and other vital parts. 92 positions where accuracy and rigidity are permanently assured. It's no Sapjap.

. . . **Engineers Only:** A special bearing requires extra tooling and different machine set-ups—delays the delivery of many standard bearings. To speed war production, consult a New Departure engineer as to availability of bearing types and sizes. Do this when your design is still "on the board." New Departure, Division of General Motors, Bristol, Conn. Detroit, Chicago, San Francisco.

New Departure

THE FORGED STEEL BEARING 3078

The pipe that can't keep a secret...



LEFT: *PYREX Pipe Lines—from 1" to 4" in diameter—are hung much like other types of piping. This picture shows the use of straight lengths, an "L", and two "T's".*

ABOVE: *This close-up of 4" PYREX Piping shows the parts used in a joint: metal flanges, asbestos inserts, and a gasket.*

THIS ginger ale maker is as finicky as a New England housewife. (Probably why his ginger ale is an Eastern best-seller.)

"I want pipe I can see through", he said, "so I know it's clean. Pipe that can't alter the flavor of my product any more than the glass bottles it is sold in. Darn it, I want glass pipe!"

Glass pipe lines, made by Corning, are a familiar sight in food, beverage, and chemical plants . . . paper mills, refineries, explosives factories . . . drug, medicine, and cosmetic plants . . . in short, wherever product purity is vital.

Highly resistant to corrosion attack, Corning's PYREX Piping eliminates this cause of contamination. Transparent, it keeps no secrets . . . a glance tells of flow, cleanliness, color, sedimentation. And freedom from pitting and scaling means long life for these pipe lines, with low maintenance costs.

Important? Yes. For in today's urgent program there's no place for impure products, production stoppage, high maintenance costs, or wasted materials. And in many instances, glass has proved it can outperform metals, do an essential job better and at a lower cost.

To the engineer, this glass piping is important as an example of the many-sidedness of glass in industry and of Corning research in glass . . . research that takes in its stride such divergent tasks as the making of a tiny chemical-resistant glass spring, smaller than your thumb, or the casting of the world's largest telescope mirror, a giant one-piece disc 20 tons in weight. Today more than ever Corning is headquarters for research in glass. Industrial Division, Corning Glass Works, Corning, New York.

CORNING
means
Research in Glass

MAGNESIUM ★ *from the sea . . .*

By August Uttich

Freshman in Chemical Engineering

Near the spot where Stanford University students do their daily labors, close to the present key city of San Francisco, a new plant has been erected; and late in August it started commercial production of ingot magnesium. In Palo Alto, California, the Permaneate Corporation has opened the second plant in the United States for the production of this metal, proving that it is possible and profitable to produce it by the reduction of the ore with carbon.

As an alloy, magnesium is most largely used in the manufacture of airplanes. A single airplane, on the average, uses 985 pounds of magnesium in its construction. Crankcases, oil pans, pistons, landing and tail wheels, cockpit fittings, door frames and housings are ideal parts of the planes on which to reduce weight by the use of light magnesium alloys. One hundred pounds, it is estimated, can be saved by using magnesium instead of aluminum in the five foot landing gears of some planes.

Though these uses seem most important in the present emergency, and are, indeed, most important, they are by no means the only commercial uses for the metal. Parts of cameras, golf club heads, parts of typewriters, and artificial limbs all employ, in their manufcaure, alloys of magnesium. It is a deoxidizer in metallurgy. It is extremely valuable in flash bulbs and in flash powders. From this can be seen its apparent use in incendary bombs and flares.

After the war in 1918 two companies were producing magnesium commercially. The American Magnesium Corporation, however, discontinued and turned to manufacturing magnesium alloys and fabricating alone. This left the Dow Chemical Company the sole producers of ingot magnesium. Their process, the Dow Process, is essentially electrolytic.

By taking advantage of differences in solubilities, a relatively pure magnesium chloride salt can be obtained by crystallization of brine taken from the sea, and sometimes prepared from salt deposits. The impurities, magnesium hydrate and calcium chloride, are removed by a carbonating process which concentrates the magnesium chloride and leaves a chalk waste. From the magnesium chloride crystals, the water of hydration must be removed. Five parts of this can be driven off by gentle heating, but the persistent sixth requires a dry hydrogen chloride gas stream to pry it loose from the compound. Fused magnesium chloride is then electrolyzed to obtain 99.95% pure magnesium and chlorine, which is likewise an invaluable product, especially in wartime.

The method used by the American Magnesium Corporation during the last war, called the oxide or fluoride process, was likewise electrolytic. Magnesite ores were calcined, the oxide was fused, and to it was added barium fluoride to make the bath more fluid and a very small amount of sodium fluoride to conduct the current. When the current was passed through the bath molten magnesium and oxygen were obtained. The chief difficulty in using this procedure was the low solubility of the magnesium oxide (0.1%). In addition, a half pound of carbon anode was consumed for each pound of resulting magnesium.

Dr. Fritz Hansgirg over twelve years ago originated a process for the production of ingot magnesium by reduction with carbon. The Austro-American Magnesite Company has been experimenting with this inexpensive method and has for some time had a commercial plant in Radenthein, Austria, and recently, in England and Korea. It was Dr. Hansgirg who supervised the building of the Permaneate plant at Palo Alto, which began last March by certificate of the Office of Production Management.

In this process, magnesite ores, which will at first be taken from Luning, Nevada, deposits (41.6% Mg.) must be calcined as in the fluoride process. Anthracite, coke, or charcoal are mixed with the magnesia in their ratio of combination according to the equation:

$$MgO + C = Mg + CO$$

The mixture is finely ground, mixed with a tarry substance and pressed into blocks. When these blocks are placed between the electrodes of an electric furnace at 2100°C and the electric current passed, the carbon reduces the magnesium according to the above equation.

Magnesium vapor and carbon monoxide leave the furnace at a temperature of 2000°C. If allowed to cool normally, a reaction the reverse of that above takes place, reoxidizing a great part of the metal. But according to the process outlined by Dr. Hansgirg, a gas, neutral to magnesium, is introduced to "shock chill" the mixture, taking the carbon monoxide by surprise, so to speak, before it can recombine with the metal. The powdered magnesium dust obtained is filtered through wool bags.

Yet, the engineering is not complete. The dust is only from sixty to sixty-five percent pure. The powder must now be pressed and distilled. For this distillation, vacuum retorts have been devised since hot magnesium burns violently in oxygen and air. Crystals of distillate are at last melted and cast into ingots.

The residue from the vacuum retorts, which is nothing but recombined magnesia and carbon, is again briquetted so that no waste occurs there. The "chilling gas" is often hydrogen. In this case, the monoxide can be removed through action with steam and lime. In the Permaneate plant, natural gas is being employed, which, after its use in "chilling," is led as water gas to the nearby cement mill to be burned as a fuel. It requires over twenty volumes of "chilling gas" to lower one volume of the magnesium vapor and monoxide to the necessary 200°C. The gas can be used over without repair till a 7 or 8% CO concentration is reached. The power required is only 22000 kilowatt hours per ton of metal.

The only difficulties of this procedure are the dangers in handling the explosive magnesium powder and the equally explosive hydrogen or natural gas. It seems, however, that under the direction of Dr. Hansgirg these difficulties have been overcome.

In a government sponsored test plant in Pullman, Washington, revisions of the Hansgirg method are being tried. Most important of these is the use of oil pressure to chill the gaseous mixture. This eliminates danger from an explosive gas and since the oil absorbs the magnesium dust and forms a film around the exit of the products, greatly reduces the danger from the metal itself.

The production of magnesium is a growing industry that will be important in war or in peace. And the new Hansgirg method, quick and inexpensive, is another triumph for science and engineering.

FRONTISPIECE:

TVA's PICKWICK DAM will produce an additional 36 million watts of electric power for defense industries when this generator shaft flange turns. John Kelcker, veteran machinist, is shown making the bore for the governor which maintains the speed of the 45 ton shaft at 81.8 revs. per minute. (Cut courtesy of Westinghouse).

Bigger Future Seen for

SUBMARINES ★

of the United States Navy

Although the inception of the submarine boat dates back to the seventeenth century, it was not until three hundred years later that practical development was begun. The rapid development that has since taken place is realized by results of its use in the first World War and in the present conflict.

In 1900 the U. S. Navy added its first submarine. The ship was torpedo shaped, had a length of 53 feet, a beam of 10 feet, and a 74 ton displacement.

DEVELOPMENT OF SUBMARINE

Many varied engineering problems were yet to be solved, however, before the submarine could be effectively used as an implement of war. The distribution of weight, for example, is of prime importance for, unlike a surface vessel, the submarine has a comparatively small reserve buoyance. It is suspended like a balance scale and must be in equilibrium in a horizontal position. The balancing moments about this point must be gained as far as possible by the distribution of all machinery, equipment, and fixed articles because the displacement limitations allow only a relatively small weight of permanent ballast to be utilized, and can be of but little assistance in effecting the trim. The laws of submarine navigation demand that the center of gravity and the center of buoyancy be kept as far apart as possible.

Speed and power estimation is a second engineering problem of great importance. In estimating the speed and power required for the propulsion of a certain proposed design, there are three factors which determine propulsive efficiency: engine efficiency, propeller efficiency, and hull efficiency. The propulsive efficiency is the ratio between the E. H. P. (or two-rope Horse Power) and the I. H. P. taken at the cylinders of the engine. In actual practice, this value ranges from 42 to 62 per cent of the I. H. P. The final verdict as to the actual efficiency is based on a chart of speed and power curves which must be drawn up to accompany each new design.

The first practical means of motive power installed in a submarine was the steam engine, but this was found to be of little use in such an application. Internal combustion engines solved the problem to some extent, but obviously these could not be used for submerged locomotion.

ELECTRICAL POWER PLANTS

Although the ideal form of power plant for the submarine is one that is capable of operation both when the submarine is on the surface and when submerged, so far as is now known no such system has yet been devised. At the present time the submarine is equipped with a Diesel engine for surface operation and with a direct current motor for use below water levels. The preent motors are ruggedly built, have their armatures mounted on the main shafting of the engines, and are well insulated. They are interpolar, D. C. ventilated type, capable of running in either direction under great variations in load. They are often operated at an overload of as much as 90 per cent without injurious heating. A potential difference of about 70 volts is allowed at the field terminals to provide for speed regulation when running as a motor and for adjustment of voltage when operating as a generator. When the Diesel engine drives the motor as a generator, storage batteries of the "Lead Cell" or of the "Edison" type are charged. Neither type of battery may be called ideal for this use, though rather efficient operation is secured by the use of either.

The problem of navigation for some time was of great consequence in the effective use of submarines. Until the advent of the gyroscopic compass, navigation was more or less a combination of dead reckoning and luck, for the hull is constructed of magnetic material and large electrical currents flow throughout the ship constantly during operation, the variations of the needle of an ordinary magnetic compass rendered it useless in submarine navigation. Attempts were made to overcome these difficulties by mounting the compass outside the ship in a composition helmet, but all attempts of such a nature proved fruitless, and were finally given up with the invention of the gyroscopic compass. Navigation worries were over.

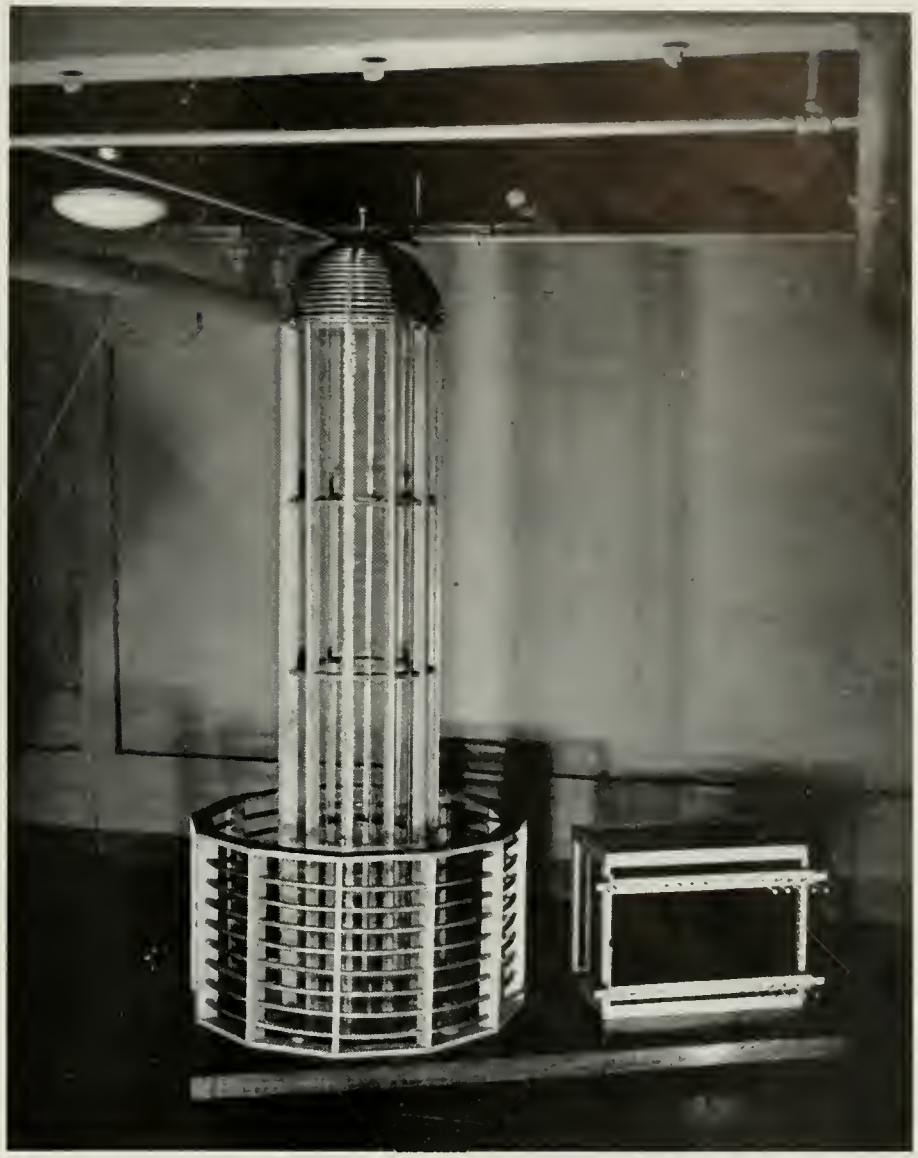
The advance in communication systems and signaling devices has kept pace with the rapid improvement made in other submarine equipment. For surface navigation, the submarine is equipped with practically the same signaling devices as any other shipflags, sirens, bells, and lights. For outside communication, a wireless sending and receiving set is among the usual equipment. But here too, engineers have yet to solve some problems, for at the present time the radio can be used only when the boat is on the surface of the water. It is now necessary to break all electrical connections on the outside of the hull and close a watertight joint before going under water. No wireless messages can then be sent or received until the submarine returns to the surface and the radio is literally reinstalled on the ship's deck.

UNDERSEA LIVING

Perhaps the factor which should be considered as secondary only to efficiency and safety is habitability. At its best, service on a submarine is almost "a dog's life." The physical endurance of the crew is one of the chief factors which now limit the radius of action of a submarine; hence every possible effort should be and is being made for the crew's comfort. Comfortable berths, dry lockers for storing clothing, wide decks for fair weather cruising, and an efficient heating plant all make for this end. An electric range and ice box are among other items which make for the contentment on the part of the crew.

Looking to the use, past and present, of the submarine in the present conflict, we arrive at a safe and sane conservative deduction as to what the future development of the submarine will bring about. Certainly the goals to be attained are evident: a roomier craft to provide for a less cramped crew's quarters; a new power plant which will operate both above and below the surface of the sea; a new development in radio which will provide outside communication during the time of submersion; an increase in surface speeds and cruising range; further improvements in mine laying apparatus, cable cutting devices, and more efficient means for the rapid handling of torpedoes.

Engineering must march onward with America to victory!



Right: Giant Telsa Coil, one of the larger exhibits at the Electrical show.

★

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R. E. TAYLOR
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L. S. BIRKS, JR.
Programs

1942 ELECTRICAL SHOW

FEATURES VICTORY PROGRAM April 9, 10, 11

Every two years our campus is stirred by the approach of a most singular attraction. Emotions run high and amid the wondering and anticipation young lovers substitute for their usual topics of conversation prolonged discussions about this forthcoming event. "What," you may well ask, "can this awe-inspiring thing be?" "A personal appearance of Gypsy Rose Lee? the 'Dance of the Seven Veils'?" No, the big event is the 1942 ELECTRICAL SHOW!

Maintaining their reputation built up in years past, students of the Electrical Engineering and Engineering Physics departments have planned a show which is both entertaining and instructive. For those of scientific bent, there will be such exhibitions as the high-voltage Tesla Coil, capable of producing 12-foot sparks; the "Floating Dishpan"; and many others. For those of less scientific tendencies, such attractions as the Kiss-O-Meter will be featured. The *use* of this interesting device we will leave to your imagination—only one guess needed!

It was suggested that in view of developments dating from December 7, last, we abandon plans for a show this year. It was decided, however, that a show this year could definitely contribute to the public morale by focusing the attentions of the public to the great advances on the front of Engineering. In keeping with the times, the underlying theme chosen for the 1942 show is "National Defense."

Many exhibits will this year be of a military nature, such as the radio-controlled tank, or perhaps a model of a magnetic mine now under construction. Other exhibits, while not of obvious military character, will suggest a definite military application. It is hoped an exhibit demonstrating the micro-wave phenomenon may be made. These ultra high frequency radio waves may be used for the detection of enemy airships and submarines far more effectively than any other medium. Obviously care must be made to not liberate military secrets by such an exhibition.

The dates for this year's show include April 9, 10, and 11. Circle these dates on your calendar and plan to attend. The combined efforts of the Engineering Physics and Electrical Engineering departments will guarantee you'll never regret it!

Professor Kerst's

BETATRON

New Electronic Developement

By Robert E. McCleary
Junior in Mechanical Engineering

★

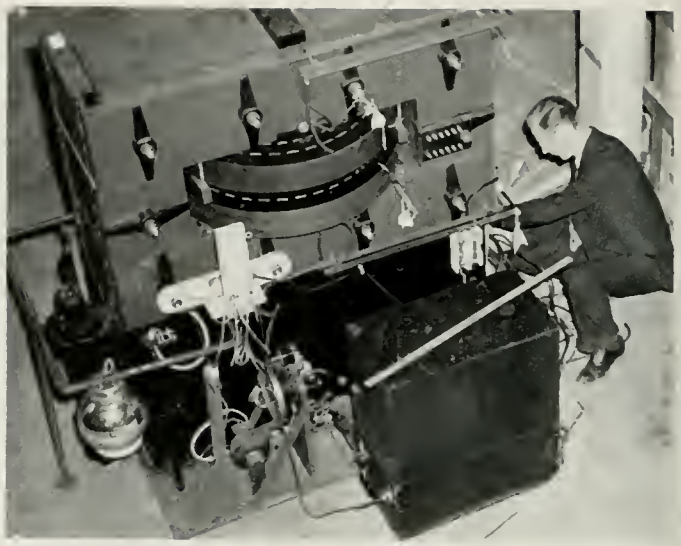
Tall, young, Professor Donald Kerst of the University of Illinois Physics Department has just completed the installation of a machine which develops the most powerful X-ray in the world, and has many important possibilities in industry, medicine and atomic research.

It is called "The most important invention of a decade in the field of atomic physics," by President Arthur Cutts Willard, head of the University of Illinois and himself a noted engineer.

The name Beta-tron is a combination of words. Beta refers to the electrons, or Beta particles which are accelerated, and 'tron' is a Greek word meaning "agency for producing."

The machine is now installed in the new Abbot power plant, within a two-foot thick wall of concrete blocks to shield its penetrating rays. It is an induction electron accelerator, doing for the electron what the Cyclotron does for the positive ions. In it, electrons, the negatively charged, satelite particles of atoms are accelerated to a velocity of nearly that of light, 186,000 miles per second, the fastest ever attained by artificial means.

Closeup view of the "doughnut," heart of the Betatron.



Professor D. V. Kerst of University of Illinois with Betatron. General view.

A doughnut-shaped vacuum tube placed between the poles of a powerful magnet from the heart of this revolutionary device. Inside the tube, magnetically guided electrons are accelerated for 200 miles in a circular orbit, obtaining an energy of 20,000,000 volts before crashing into a tungsten target where X-rays of the same voltage are generated. The X-rays are equal in intensity to the gamma rays from 1000 grams of radium, more than the present world's extracted supply.

The machine weighs 4 tons, to the massive Cyclotron's 80 tons. Its electro-magnet is 5 feet long, 2 feet wide, and 3 feet high, and contains between its poles the doughnut tube whose outer diameter is 18 inches and whose inner diameter is 12 inches. A steady push of as much as 70 volts per revolution, speeds each electron on its dizzy journey.

The Cyclotron cannot accelerate electrons, and high velocity electron beams have not kept pace with experiments done on positive ions by that machine. Former machines have reached a practical limit of electron acceleration of 1 6 Dr. Kert's machine, or 3 million volts.

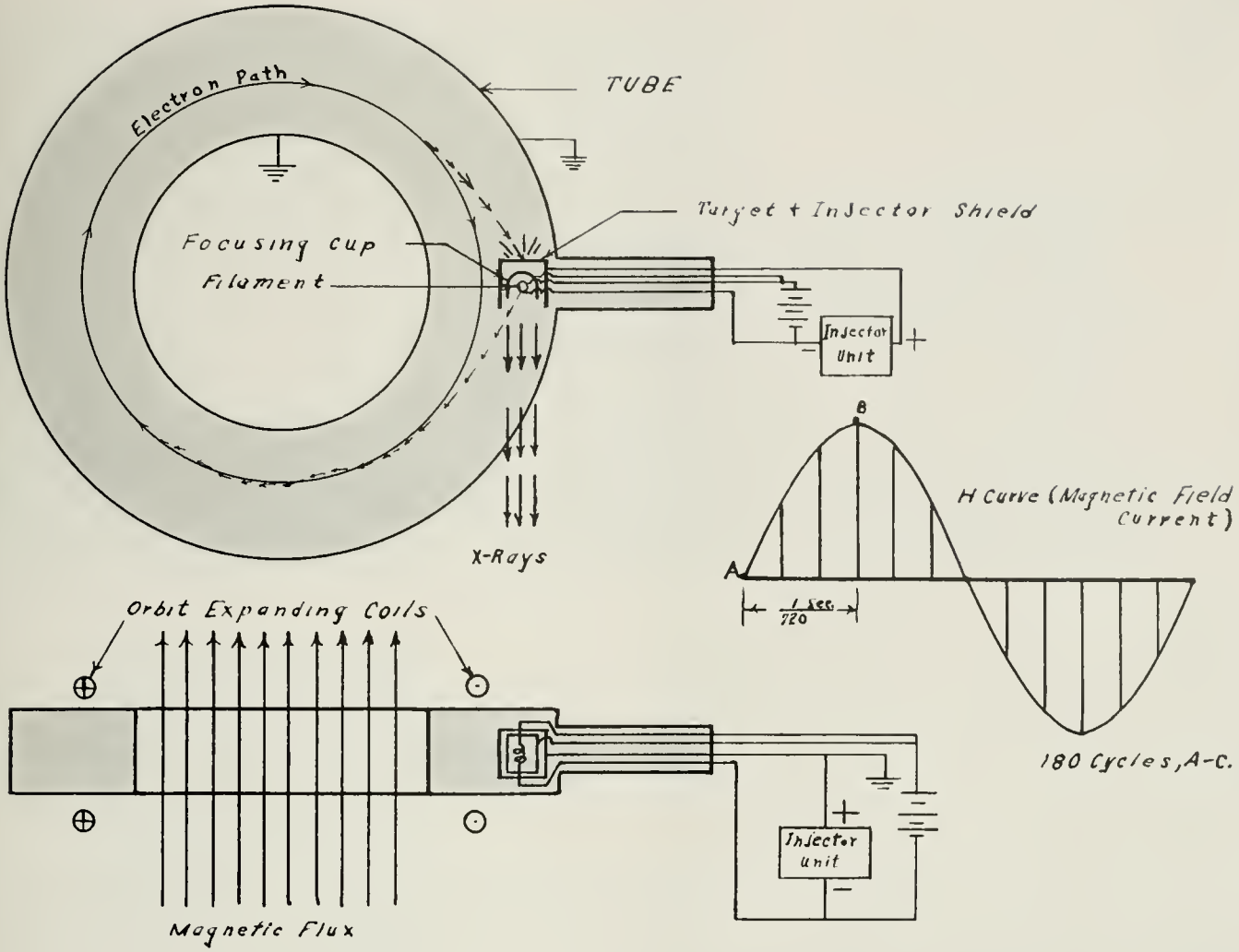
Furthermore, there seems to be no limit to the energy of the induction accelerator. Apparently its effective voltage can be increased indefinitely. Dr. Kerst directed his efforts toward the development of a 100 million volt accelator and spent the past year at the General Electric Research Laboratory, building his present intermediate 20 million volt Beta-tron.

It was while a bid was being solicited for the manufacture of the 100 million volt machine to be built for the University of Illinois that the Company confiscated his plans in order to make the machine for themselves.

Scientists here believe that such a machine may artificially produce Cosmic-ray phenomena. At present, journeys to lonely mountain tops are necessary for study of these mysterious rays from outer space. Perhaps a year's work on Cosmic rays could be accomplished in a day by a machine which produced Cosmic ray effects in the laboratory.

OPERATION . . .

In the purely diagramatic drawings on this page are seen the principle elements of the accelerating tube. At lower left is seen the magnetic flux which is produced in the laminated field magnets by the AC current from points A to B on the sine wave shown. About 20 watts are absorbed by the whirling electrons, which increase their masses



40 fold because of the relativity effect as they approach the speed of light.

All engineers who have taken physics will realize that if the doughnut tube contained loops of wire instead of whirling electrons, the changing magnetic flux would cause an E.M.F. of (f) $N \times 10^{-8}$ volts, where (f) was the flux, and N the number of turns of wire, to be induced in the loops.

This is the neucleus of the revolutionary idea for such high voltages and electron velocities as obtained in this machine. Actually the loops of wire (corresponding to the secondary of a transformer coil) are replaced by electrons which circle 450,000 times, the equivalent of the same number of turns of wire, with a 70 volt peak per revolution.

The hot filament glows continuously and electrons are injected into the doughnut by sudden application of a potential difference between the filament and the injector shield. This voltage is applied briefly at time A, approximately. After injection, electrons are caught and started on their dizzy trips. Dotted lines show how the electrons are curves toward the normal orbit and wavers from side to side before finally settling down to whirl 450,000 times about the tube in the time the current has changed from A to B, 1-720 second.

An additional surge of flux through the center of the orbit, when magnetic field has reached peak value, B, expands the orbit outwardly, causing the electrons to impinge upon back of injection structure, which acts as a target.

This tungsten target so bombarded, emits powerful X-rays in a strong concentrated, directional beam, as shown. As soon as the current wave has traveled 2 Π or 1-180 second, the same cycle repeats itself. Electrons are whirled one way, only. The tube waalls are 1-4 inch thick and its silvered inside surfaces are grounded. Occasionally a stray molecule of gas is struck by the whirling electrons and X-rays may be emitted in any direction, right through the walls of glass.

The X-rays have been shown able to convert copper to its radioactive isentrope which then decays to nickel. In principle, every element known is susceptible to this transmutating effect.

Professor Kerst was born in Galena, Illinois, and later lived in Wauwatosa, Wisconsin. There, while helping a neighbor build an amateur radio station, he became interested in science. He attended the University of Wisconsin, where he received his AB. degree in 1934 and his Phd. degree in 1937. He is an honored member of Phi Beta Kappa, Sigma Xi, and Gamma Alpha.

At Wisconsin, he did research work with Dr. Raymond Herb and Dr. David B. Parkinson with pressure electrostatic machines. This work attracted attention in scientific circles, and led several institutions to construct similar machines for neuclear research.

Then Professor Kerst worked for a year on X-ray tubes in the General Electric X-ray Corporation laboratory in Chicago. In 1938, he came to the University of Illinois, where he built the first electron accelerator, a table-top size machine of 2 and 1/2 million volt energy.

Much more will undoubtedly be heard of the Beta-tron, for research with it has scarcely begun. The University may be justly proud to have on the faculty such a distinguished and competent a genius as Professor Kerst.

Fluorescent Lighting

Modern Illumination

★

By Hayward L. Talley
Freshman in Electrical Engineering

(Illustrations courtesy General Electric Company.)

In war indstries, fluorescent lighting is helpng to speed up production. Here a welder is "doing his part" on the night shift in an airplane factory.

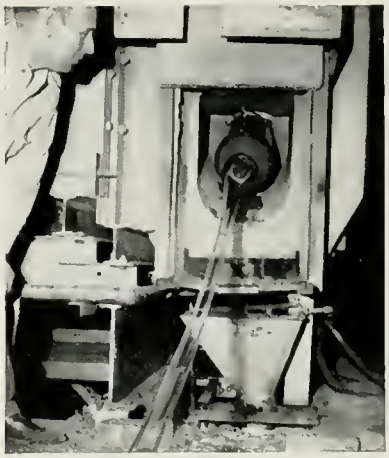
Shedding an abundance of pleasing light over the drawing board, the office desk, the drill, the lathe, and the kitchen table, is a new type of lighting unit which has won the praise of the draftsman, stenographer, industrial worker, and homemaker alike. During 1941 alone over twenty-two billion fluorescent tubes were purchased by the American public.

Actually, fluorescent illumination is not as new as it would seem, for as early as 1570 a Spanish physician, Nicolo Monardes, noticed that when a tincture of a certain type of wood was illuminated it took on a blue color. Three centuries later the English physicist, Sir G. C. Stokes, determined the true nature of the phenomenon, and called it *fluorescence.*

About 1884, Edison discovered that if inside an exhausted incandescent electric lamp of the ordinary type, a third wire is introduced, insulated from the filament connections, and maintained at a voltage positive with respect to the filament, then a current would flow across the vacuum inside the tube from the third wire to the filament as long as the filament was incandescent, but that the current ceased as soon as the filament became cold. This phenomenon was called the *Edison Effect.*

These facts established by Stokes and Edison are the elementary foundation upon which modern flouroscent lighting is based. In contrast to the well known filament lamp in which electricity flows from one lead wire to another through the solid tungsten wire, thus heating it to incandescence, the fluorescent lamp makes use of ultra-violet energy to activate a fluorescent material coat on the inside of the tube's surface.

Below: Device testing the brightness of fluorescent powders used in the fluorescent lamps, to assure users of maximum light output throughout lamp life.



Glass tubing here emerges from a furnace in semi-liquid form.

The lamp in its present form consists of a tubular glass bulb with two external contacts at each end which are con-

nected to coiled tungsten-wire electrodes. Also within the tube is a small drop of mercury and pure argon gas at a low pressure. When electricity passes into the lamp, the mercury, vaporizes. Presently, with the aid of the argon gas, an arc forms between the electrodes at each end of the tube. Although the arc gives off a little light, most of the radiation generated is invisible ultraviolet light. The powder on the inner surface of the bulb converts this invisible radiation into visible light whose color depends upon the powder ingredients.

In common with all electric discharge apparatus, fluorescent lamps require auxiliary control equipment. The function of the starting auxiliaries is to create a momentarily high-voltage impulse in order to establish an arc between the electrodes. The auxiliary consists of two principal elements; an iron core choke coil (ballast) which limits the arc current and a starting switch which momentarily closes and then opens the electrode heating circuit. Each lamp requires a separate auxiliary, although the elements of two or more lamps may be contained in a single unit. Specifically designed ballast equipment is required for each wattage size, for each frequency, and for each voltage range.

When fluorescent lamps were first introduced a number of starting methods such as thermal switch, resonant, and magnetic switch types were utilized. Recently, how-

Hundreds of tubes, now hard and cut to length, have been stacked in readiness for assembly as lighting units.

ever, a switch known as the *glow switch* operating on the thermal principle has been manufactured. This new starting device is about 1 inch long and about 3-8" in diameter. It resembles a minature electric lamp, and contains an easily ionized gas and two bi-metallic electrodes which serve as the switch contacts. The switch is connected in series with the fluorescent lamp electrodes; when the current is turned on a glow discharge is created between the normally open switch contacts of the bi-metallic electrodes. The heat of the flow causes the contacts to close. At this point the lamp electrodes are heated to a bright red color. As the contact closes the glow discharge automatically ceases, allowing the bi-metal elements to cool and separate, opening the switch and striking the arc in the lamp. The whole operation from the time the current is applied until the arc is established requires only one to two seconds.

Power consuming apparatus of the *inductive* class such as coils and other current limiting devices have a lagging power factor. For this reason the equation for power applied to fluorescent lamp installation is: Watts=volts×amperes ×power factor. The power factor of the average fluorescent lamp itself is about 90 per cent. Due to the ballast choke, however, the power factor for the complete unit is reduced to 50 or 60 per cent. This low power factor is expensive and undesirable, hence in order to improve the power factor, a suitable condenser is connected across the choke coil. In the case of two lamps operated from ballasts housed in the same unit, the *split phase* principle is used; one of the lamps is ballasted by inductive reactance only and the other by inductance and capacitance in series.

Comparing fluorescent equipment with its predecessor, the tungsten (filament lamp), the filament lamps produced a great amount of radiant heat; fluorescent lamps produce

Finished fluorescent lighting tubes are assembled on racks for final inspection and test.

about one-fourth that produced by filament lamps for the same amount of light delivered. The fluorescent tube, for this reason, is well adapted for nearby use. Fluorescent equipment has a *low surface brightness*, making it possible to increase the comfort level of a lighting system, and

(*Please see page 22*)

Below: Light output test—one of the scores of tests by means of which the manufacturers assure users they are getting the best in quality.

NAMES

. . . *in the news*

By William R. Schmitz
Freshman in Chemical Engineering

BOB DEBS

Bob Debs is a member of Sigma Phi Delta, Sigma Tau, Pi Mu Epsilon, and corresponding secretary of Tau Beta Pi. Last year Bob was general chairman of the music committee for the music hour at the Union Building. Tall, thick-spectacled and dark haired, this remarkable personality hides behind an easy smile.

As you might suppose, music is one of Bob's hobbies. Another hobby, which you would be equally unlikely to guess, is hitch-hiking. In fact, Bob likes it so well that he hitchhiked all the way to New York and back last summer. And if you don't know why he would go that far, just remember the rumor—It was to see a certain little lady. He wouldn't tell your columnist whether she was a blonde, brunette, or a red-head, but he admits liking all three!

He tells freshmen to form two things quickly—study habits and friendships. He says that at Illinois you will meet people who will be your friends for life, and the best thing is to make as many friendships as possible.

Bob has found particular enjoyment in mathematics, physics, and English literature. As an engineering physicist

BILL

GEORGE

Bob expects to go into research and development work. He is very interested in X-rays and electronics. His laudable hope is to be able to do something of benefit to science and man.

BILL WUELLNER

Home town boy makes good! That is the story of Bill Wuellner. Bill is a resident of Urbana and lives very close to the campus. Bill thinks that he has an advantage over the other fellows in being able to stay at home. He appreciates those home-cooked meals, but wishes that he was a little more independent and did not have to account for his every move.

Bill is also an electrical engineer of some reknown. Specializing in power, Bill once came close to having an accident. He caught hold of a 220 volt wire and could not let loose. (He lived to tell us about it.) Bill is a member of Eta Kappa Nu, Phi Eta Sigma, Beta Kappa, Phalanx,

JOHN

BOB

T.N.T., Pershing Rifles, A.I.E.E., and is chairman of the forth-coming Electrical Show.

Bill is a true gentleman, scholar, and soldier. Right now, Bill's main thought is military. He is looking forward to his sojourn in the army with enthusiasm. A Cadet Captain in the Engineers, Bill puts in about ten hours a week on military subjects and drill. Although he is not looking ahead into the future too much, Bill admits that he would like after the war to have a responsible position with a good salary, a nice home, and a good wife.

He likes the same things that you and I like, including the ever popular female. He says that Illinae are a fine bunch of girls, but insists that we make "co-ed" singular. Not only is he a good tennis and golf player, but he is also a good bowler. His pet peeve is that he can never find a bowling alley open when he wants to go bowling.

JOHN FICOR

John Ficor, senior M. E., is a quiet, mild-mannered individual with a great love for engineering. Interested in engineering since his early boyhood, John began looking about for the best engineering school. Quite naturally he chose Illinois, chiefly because of the reputations of the engineering professors here.

Although John doesn't have a whole lot of spare time, he says that outside activities are vital to a college student's life. He particularly stressed that these activities should tie up with your profession some way. Some of the organizations to which he belongs are: Phi Eta Sigma, Sigma Tau, Pi Tau Sigma, Tau Beta Pi, Scabbard and Blade, and A.S.M.E. He holds the rank of Cadet Captain in the Field Artillery.

This stalwart son from Madison, Ill., has a few hobbies that he likes to pursue in his spare time: building model airplanes and reading fiction books, playing baseball and swimming. Also a music lover, especially of light opera, John's favorite piece is Andre Kostelanetz's *Begin The Beguine.*

Right now, John is interested in writing a thesis on the photo-elastic investigation of design of railway car-wheels. Principally interested in design and power, John has especially liked his T. A. M. and Design courses here at school, which may contribute to his good 4.55 scholastic average.

John likes the way the campus is laid out, but insists that the Alma Mater statue is in the wrong place. He believes that it should be in a more prominent place, and we are inclined to agree with him.

GEORGE DACEY

The greatest music lover of the E. E.'s is genial heavy-set George Dacey. George's interest in music dates back to

(*Please see page* 22)

More aluminum up there, less in new telephones —for victory!
Many materials used in telephone making are listed as "critical" for war purposes. Bell Telephone Laboratories and Western Electric have redesigned apparatus and changed manufacturing methods to employ available materials.
Take aluminum. The reduction in its use in a year's telephone output is enough to build 294 combat planes. This program has been replacing critical materials at an annual rate of 7,747,000 pounds. Though it grows steadily more difficult to maintain as shortages increase, the program helps to meet the greatest demand in history for military and civilian communication equipment.
"THOSE PLANES WILL HELP DADDY LICK 'EM!"
Western Electric
. . . is back of your Bell Telephone service

TECHNOCRACKED . . .

By Edward C. Tudor
Senior in Electrical Engineering

•

Even with a war in full swing there is still a preponderance of humor available along all the walks of life. We would like to pass along a few of the more inane items from the newspapers that we think deserve comment.

For instance, two Chicago policemen who went to the rescue of a duck, apparently frozen in Lake Michigan, fell into the icy water. The duck flew away. This bird has evidently been reading the comic strips.

"You can provide food, bedding, and shoes for a horse today for 50 cents a day."—New York Daily Mirror. —Wanna bet?

Headline: "Speed Wastes Tires." And pedestrians, too! "Wanted—Fireman. Hotel experience. Apply sober. 503 Times."—New York Times. Need we say anything!

"A whispered word in Dallas, Tex., that only black candles would be allowed in blackouts caused a run on them. One dealer sold 10,000 before the public became aware of the hoax."—St. Louis Globe-Democrat. Quick Jeeves, the gold bricks.

"Hess is where he ought to be,"—Churchill. If this be the case we hope Dante had the right idea about things down there.

"Dishwater recommended as poison antidote." No thank you, we'll put up with the arsenic.

It's a duty to drive carefully club is told." And against the law to drive any other way, in case you're interested.

76 tires stolen in city; 76 permits for new ones issued." Well, at least they're holding their own.

Then there's always some good ones from the war situation, to wit:—

Headline: "Nazis Willing to Rule the World." We'll bet that if they had half a chance they'd fight to do it.

"Goebbels tells Germany it will win or lose all." We get the impression that he's half right at that.

"Biggest gun in army on display in Chicago." Guard it well, fellows, don't let those Chicago torpedoes get hold of that thing.

"War work aided by surplus corn." At least it helps some Engineers to forget their worldly troubles.

"Another German General ailing." Better rush a surgeon, Adolph, before the guy gets well.

And along the same lines: "Soviet Ambassador in Tokyo leaving because of ill health." He'd better hurry before the Japs decide to operate.

We understand that there are so many office-holders in Washington now that the government is putting names on revolving doors. In fact, a railroad ticket agent fainted at his window the other day when a man asked for a round-trip ticket to Washington.

It is standard practice these days when entering a night club for one to hang his hat and coat on a fireplug and check the spare tire.

We know it was Talleyrand, but it might well have been "Buck" Knight, who said of coffee, "It must be pure as an angel, strong as love, black as the devil, and hot as hell."

We just finished Groucho Marx's new book on income taxes, "Many Happy Returns." We're convinced that a better title would have been "Many Slap-happy Returns." The book greatly clarifies ou rquestions on the case of a befuddled fellow in Berkley, Cal., who made out his tax return then committed suicide. A tavern owner in Chicago found an easier way out. After tax auditors had billed him for $1700 he replied with the following laconic note,— "Tavern is yours, I'm going Jap hunting."

From Howard Brubaker in The New Yorker, "Many officials of the Coolidge and Hoover administrations are being pressed into the service of their country. In this crisis, our leaders are not too proud to use reclaimed Republicans."

Directions for extinguishing an incendiary bomb from the San Francisco Chronicle; "If water is applied too rapidly, an explosion is likely. Never apply water directly from a bucket. The best method is the application of water directly from a bucket." We're giving odds on the bomb.

(*Please see page* 19)

Remember Last Year?

For a smooth evening it's the engineer's dance at the Union Ballroom

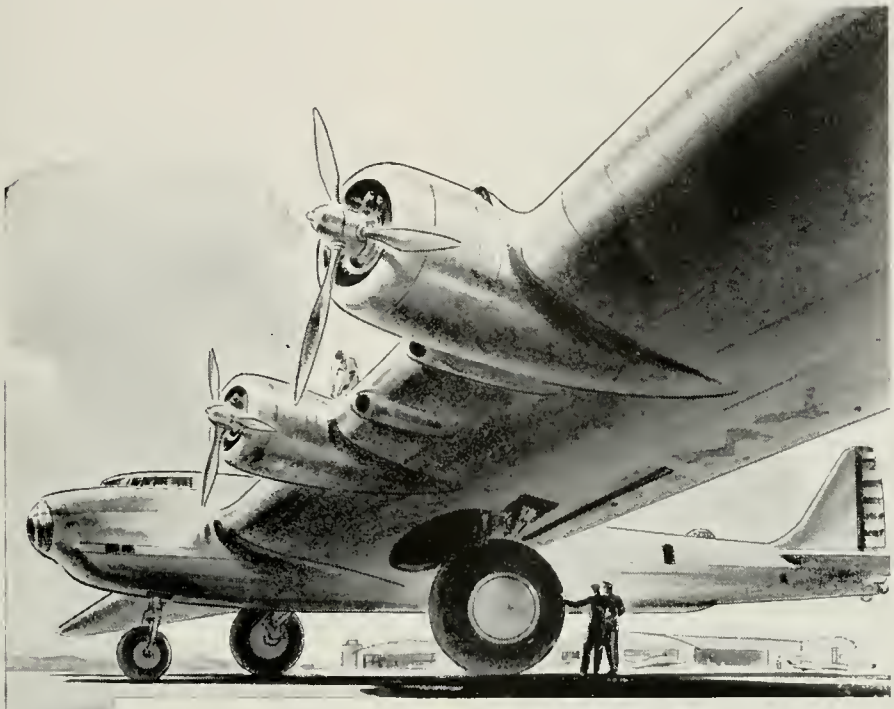
Slide Rule . . .

SHUFFLE

FRIDAY, MARCH 20
Informal

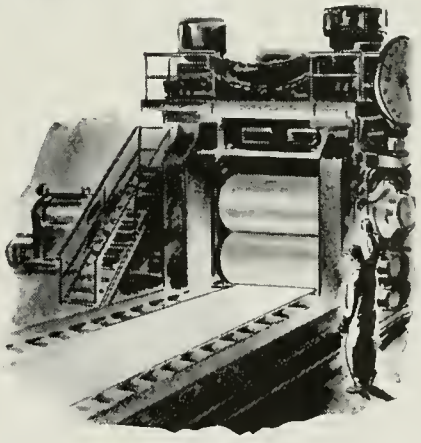
Tickets to Engineers $1.75 per couple

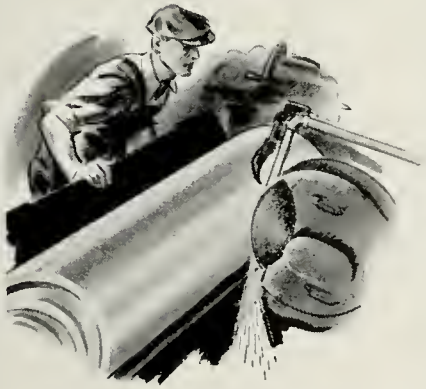
What does it take to smooth a Warbird's Feathers?



A wingspread of 212 feet ...every inch preened sleek as satin! The perfect smoothness of the metal sheathing on American warbirds like the B-19, world's mightiest bomber, isn't there for looks. It's essential to top performance. How do they get the flawless sheets of metal used to make airplanes? They're rolled out by the ton by giant steel rolls. And keeping the surfaces of these rolls ground to almost perfect accuracy and finish is another of the vital contributions of Carborundum-made wheels to America's defense.

Thousands of other products for defense and for normal needs are made by the rolling process. Plate glass for your car, steel rails, plastics, tin plate and paper are only a few. And since their surfaces can be only as perfect as the faces of the rolls that roll them, finish is highly important. Today, surface quality of rolls can be maintained to within a few millionths of an inch by the use of Carborundum-made grinding wheels.





The same skill and experience that have helped develop modern roll grinding technique will be at your disposal in any industry with which you may become associated. Whatever the use of grinding wheels or coated abrasives, Carborundum engineers are ready at all times to advise and help. The Carborundum Company, Niagara Falls, New York.

CARBORUNDUM
REG. U.S. PAT. OFF.
ABRASIVE PRODUCTS

Carborundum and Aloxite are registered trade-marks of and indicate manufacture by The Carborundum Company.

Return of the Carbon Age

CARBON . . . one of Nature's oldest and most plentiful materials . . . is making possible some of industry's newest achievements.

In the *chemical* industry, massive black towers of carbon . . . erected in incredibly short periods of time . . . speed the delivery of vital acids. The all-carbon electrostatic precipitator . . . built of carbon from the bottom to the top of the stack . . . is now an actuality. Such towers can be erected in as little as a *week's time!* Staunchly immune to corrosion and thermal shock, they should last *indefinitely*.

Today . . . due to basic and applied research into the properties of carbon and graphite . . . it is possible to obtain these black, wonder-working materials in such a variety of forms—blocks, bricks, beams, tubes, pipes, and fittings . . . even valves and pumps . . . that almost any size or shape of structure can be built from them. For making tight joints, which give the structure uniform properties throughout, special carbon- and graphite-base cements have been developed.

Undisturbed by the torture of heat, carbon is also a "must" in the *metallurgical* industry. Carbon *cannot be melted* . . . will not soften . . . and has remarkable dimensional stability even at incandescent heat. In addition, it will not flake off and hot metal will not stick to it. That is why it is ideal for such uses as molds, cores, and plugs . . . for the lining of furnaces . . . and for sampling-dippers.

Because electric-furnace graphite conducts heat even *better than most metals,* it is becoming increasingly important in the manufacture of heat exchangers for the processing of corrosive liquids and gases.

These new uses for carbon and graphite . . . added to the almost interminable list of uses that existed before . . . make this era truly a carbon age. Your inquiries are cordially invited.

The strides made in the development of structural carbon, and in the uses of other carbon and graphite products, are greatly facilitated by the technical assistance of other Units of Union Carbide and Carbon Corporation including The Linde Air Products Company, Carbide and Carbon Chemicals Corporation, Electro Metallurgical Company, Haynes Stellite Company, and Union Carbide and Carbon Research Laboratories, Inc.—all of which collaborate with National Carbon Company in research into the properties and applications of carbon and graphite.

NATIONAL CARBON COMPANY, INC.

Unit of Union Carbide and Carbon Corporation

30 East 42nd Street UCC New York, N. Y.

This all-carbon electrostatic precipitator stands 55 feet, 2 inches high.

TECHNOCRACKED

(. . . *from page* 16)

Daffynitions: Bigamist—a man who doesn't know when he's had enough.

We note that Donald Nelson is one of the three most noted Nelsons in history, the other two being Lord Nelson and half Nelson.

The only spy killed over here was sideswiped by a taxicab in New York's Times Square. And they took the driver's license away for two months!

We close with the following reproduction of some of the questions and answers supplied by Gracie Allen on a routine questionnaire filled out when she reported for her newest picture.

Professional name—"Gracie Allen" (big letters).

Travel: cities and countries, with dates—"Have travelled, but not with dates. When I have a date I'd rather park than travel, wouldn't you?"

Where educated—"Partly in school, partly listening to the Quiz Kids."

Weight—"Yes, but not where it should be."

Military record, if any—"Have one record: Sousa's 'Stars and Stripes Forever' and play it all the time."

How often attend picture shows—"Two or three times—after that a picture gets monotonous."

What would do if out of pictures—"I don't know. If you can find out what Clark Gable does out of pictures I'd be glad to help him."

Odious, huh?

We now retire to the seclusion of our padded cell to ponder that omnipresent problem during air air-raid:—whether to hide in the cellar and let the house fall in on us, or to hide in the attic and fall in with the house.

—Courtesy General Electric Co.

Night view of illuminated crossing.

Sodium Vapor Lights

Protect Grade Crossings

Illumination of grade crossings may greatly improve driving safety records. Sodium lights installed at several grade crossings in Faribault, Minn., have helped cut night accidents, according to records of the railroad's claim department. The lights are of the open type and utilize a 10,000-lumen sodium lamp in a horizontal position. Two lights are installed at each crossing on Division, Third, and Fourth Streets.

Prior to the sodium lighting, two night accidents occurred in three years at these crossings. The cases involved automobiles striking the sides of freight trains, and both occurred between midnight and 6 a. m. Two other accidents also occurred in this period, one happening in daylight and the other time unknown. In the three years following installation of the lights, only two accidents have happened at the crossings—both in daylight.

More than one and a third billion lamps, a new record, were sold in the United States during 1941, it is reported in the annual review of the electrical industry by Guy Bartlett. The estimated total of 1,350,000,000 included 718,-000,000 large and 610,000,0 miniature incandescent lamps, and 22,00,00 fluorescent lamps. Miniature lamps include automobile, flishlight, and similar lamps.

★ Buy U. S. Defense Bonds and Stamps ★

Big Interview?

The engineer who's on his toes will make sure he looks his best by seeing Lee at

★

CAMPUS BARBER SHOP

Due East from Physics Lab.

For That Morning SNACK
or a
DINNER from soup to nuts

Engineers go across the street from the Physics Building to

•

CHARLIE'S
RESTAURANT

GERMAN AIRCRAFT RADIO . . .

Not Equal to U. S. Types

Some weeks ago a German fighter plane, a Messerschmidt 109, was shot down over the Thames estuary. Arrangements were made to have the plane shipped to the United States, enabling American engineers to examine the plane and the equipment which it carried.

The radio equipment installed in the plane included a receiver, a low-power transmitter, and a power supply unit. In general, each unit was ruggedly built. The chassis of each unit is a light weight casting, manufactured from Elektron, a special alloy replacing aluminum or steel.

The units themselves are interconnected with cable and waterproof coupling plugs. The cable is fibre covered, and unlike the shielded rubber covered cable used in American designs, humidity and abrasion could cause considerable damage. The absence of metallic shielding also makes possible the entrance of undesirable interference set up by the ignition system of the plane.

THE RECEIVER occupies 750 cubic inches and weighs thirteen pounds. It is a five tube single band radio covering a range of from 2,500 to 3,700 kilocycles. The superhetrodyne circuit employs the five tubes as follows: first RF, detector-oscillator, first IF, second detector, and audio output. Plate leads are brought out at the top of the tube. A similar circuit layout was perfected here ten years ago employing tube No. 24 (R-F Amplifier Tetrode) and No. 35 (Super-Control R-F Amplifier Pentode). No. 24 also is used as a bias detector.

The coils used in the receiver are all of the air-tuned type, and even though Germany pioneered in the development and application of iron core coils, none are used except in the second IF transformer. None of the coils are impregnated with a wax protective coating, and without doubt extreme temperatures could do them tremendous damage.

The receiver output is designed for 8,000 Ω load and the maximum power output is about 70 Milliwatts. The receiver selectivity varies from 10 microvolts at the higher frequencies to 60 microvolts at the lower end of the band. The IF frequency of the receiver is 250 kilocycles, and the first IF transformer is double tuned, while the second has but one tuned circuit.

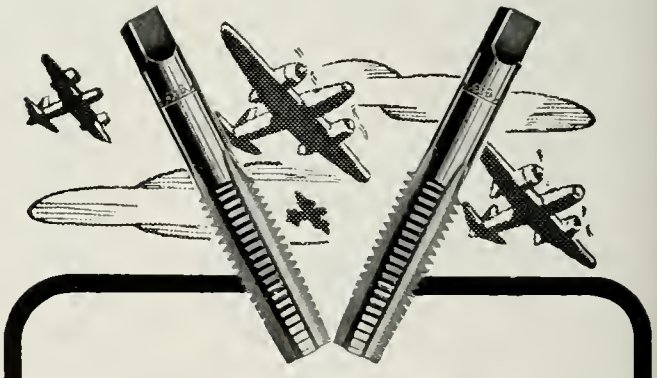
Ceramic resistors and condensors are used extensively and each is color-coded for easy identification. All resistors and condensors are mounted on a ceramic terminal board. Ceramic components are used throughout the set much the same as we use bakelite and plastics.

THE TRANSMITTER occupies 785 cubic inches of space, and has a weight of twenty pounds. It is composed of four tubes, used as follows: straight feedback oscillator, 2 RF amplifiers, and a single tube as the modulation equipment. Provision is made for the addition of a second tube of the last type in order to supply more audio voltage to the grid of the power amplifier tube if it is subjected to high plate voltage. The frequency of the oscillator is controlled by a tuning condenser in the plate circuit and is indicated on the front panel of the unit. The output of this oscillator is fed to the two RF amplifiers which are connected in a paralleled circuit. A power supply of 275 volts, 90 cycle, AC is fed from the power supply to the transmitter and here filtered and rectified for the power supply and the bias voltages for the oscillator and speech amplifier tubes.

THE ANTENNA SYSTEM consists of a short fixed antenna and a conventional "trailing wire." The antenna system is connected with the set through a variometer and an antenna selector switch. The circuit is so arranged that when on the fixed antenna position the airplane serves as a switch is on the trailing antenna position, *both* the fixed antenna and the airplane serve as a counterpoise.

THE POWER SUPPLY occupies 500 cubic inches and weighs fifteen pounds. It consists of a motor-generator unit and filters for both output and input voltages. In addition to the 257 V. AC supply to the transmitter, the voltages supplied are: 12 V., D. C. (filament voltage), and 400 V., D. C. (plate and screen voltages).

Comparing the operating efficiency of this German radio with a modern unit installed in fighter planes of the United States, there is no doubt, of the tremendous superiority of our radio equipment; our equipment weighs as low as 40 pounds as compared with sixty pounds for German equipment. Our equipment occupies about .7 cubic ft., while German equipment occupies nearly twice that space. German equipment has a frequency range of 2,500 to 3,700 kilocycles, while American equipment has a tuneable range covering the 150 to 410 kilocycle airport band, the 1500-3900 kilocycle police band, including the 2,500 to 3,700 kilocycle aviation band, and 2 short wave bands covering 3,900 to 1800 kilocycles. While each American plane has a strong enough transmitter to maintain contact with the ground, only the commanding German plane, the transmitter in which is equipped with the second tube in the modulated circuit, has a range sufficient to maintain contact with his base. Further, American aircraft radio includes a radio-compass, an item completely absent on German equipment.



To "KEEP 'EM FLYING"

"Greenfield" Taps, Dies and Gages are helping to build practically every plane and engine used by our Army and Navy.

70 years of practical experience enable these tools to meet Uncle Sam's most rigid requirements. That experience is one reason why skilled workers and production men always have confidence in *"Greenfield"* tools.

GREENFIELD TAP AND DIE CORPORATION
GREENFIELD, MASS., U. S. A.

GTD GREENFIELD
TAPS · DIES · GAGES · TWIST DRILLS · REAMERS · SCREW PLATES · PIPE TOOLS

SWEEPING STEEL WITH A BROOM OF FLAME

SWEEPING over metal structures and structural parts this modern broom of fire prepares metal surfaces for a long-lasting, protective coat of paint. It is the Airco Flome Cleaning Process and removes rust and scale and dehydrates metal surfaces as it cleans. It provides a warm, dry surface conducive to a lasting paint job and assuring a faster one. Flame cleaning is the most effective method yet devised to prepare metal surfaces, new and old, for painting and repainting. Ultimate maintenance costs are lower.

Versatile is the oxyacetylene flame. It provides better and faster ways of making machines, engines, ships and tanks by shaping thin steel plates or heavy slab forgings and structures with economical ease and with a high degree of accuracy. The oxyacetylene flame hardens steel to any desired degree and depth. It softens steel, or bends it, or straightens it. It removes scale from billets, castings and forgings.

Possibly you are interested in learning more about the machines and apparatus which harness the Airco oxyacetylene flome and put it to work in so many different ways. If so, write for a copy of the pictorial review "Airco in the News" to the Airco Public Relations Department, Room 1656, 60 East 42nd Street, New York, N. Y.

AIR REDUCTION

General Offices:

60 EAST 42nd STREET, NEW YORK, N. Y.

In Texas:

Magnolia-Airco Gas Products Co.

DISTRICT OFFICES IN PRINCIPAL CITIES

ANYTHING AND EVERYTHING FOR GAS WELDING OR CUTTING AND ARC WELDING

Fluorescent Lighting
for Varied Uses

(. . . *from page* 13)

Forty-five foot-candles of comfortable, well-diffused, fluorescent troffer lighting are provided in this office.

simultaneously minimize shadows. The color quality of fluorescent equipment is much improved over filament equipment. Most important, perhaps, is efficiency. While best quality filament lamps have a life of 1000 hours, fluorescent tubes have a 2500 hour life. Best filament lamps produce about 16.5 lumens per watt power consumption, while fluorescent tubes produce about 31.08 lumens per watt power consumption. That's why manufacturers expect the annual fluorescent tube sales to reach the fifty billion mark by the end of 1943!

IN SELF DEFENSE

TAKE NOTES
in Class

★

UNIVERSITY BOOKSTORE

202 S. Mathews 610 E. Daniel

NAMES *in the* NEWS

(. . . *from page* 14)

his early school days. Since he has been here on the campus, George has had a prominent part in musical circles. He was a member of the cast of three operas, namely: Yeomen of the Guard, Madame Butterfly, and Manon. Possessed with a fine baritone voice, George has put in some long hours in training it. He also finds much enjoyment in collecting classical records—a welcome relief to the neighbors?).

To show that he doesn't belong in the school of music, George has a fine record in electrical engineering, at present sporting an ultra-fashionable average of 4.78. When he graduates, George expects to join Westinghouse and do some graduate work toward a degree.

George claims Wauconda, Illinois, has his home town, and we may believe the people of Wauconda claim all one of him. His brilliance is not merely of recent origin, but extends at least back to his high school. for he graduated as the valedictorian of his class there.

During his four years here on the campus, George has managed to inadvertently gather a few honors. He is a member of Phi Eta Sigma, Sigma Tau, Tau Beta Pi, and Arepo, musical honorary society. He is treasurer of Eta Kappa Nu, is chairman of the publicity committee for the A.I.E.E., and is exhibit's manager of the 1942 Electrical Engineering show.

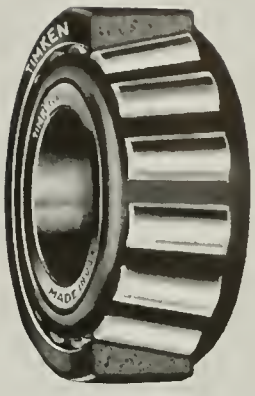
Skidding is the action,
When the friction is a fraction,
Of the vertical reaction,
Which results in traction.

Mystery . . .

1942 Electrical Show
April 9, 10, 11

Timken

Bearings are Keeping Wheels and Shafts Turning For Victory. They'll Keep Them Turning For Prosperity Afterwards.



Student engineers of today will have a terrific responsibility in the future; for upon their shoulders to a very great extent will fall the responsibility of developing new and better machines of all kinds to help in the reconstruction of the economic fabric of the nation.

A thorough knowledge of Timken Tapered Roller Bearings will be a valuable asset to every young engineer starting out on his career during the next two or three years—probably the most critical period our country has ever had to face.

Begin to acquire this knowledge now; write for a free copy of the Timken Reference Manual. Then you will be in position to master any bearing problem that may ever come up—no matter what combination of requirements it may involve; friction elimination; radial, thrust and combined load capacity; preservation of alignment of moving parts.

Send for your copy of the Timken Reference Manual today. Mention the name of your school when writing.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TO ASSURE VICTORY
BUY UNITED STATES
DEFENSE BONDS & STAMPS

Manufacturers of Timken Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; Timken Alloy Steels and Carbon and Alloy Seamless Tubing; and Timken Rock Bits.

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

G-E Campus News

BLACKOUT WATCHMAN

THE problem of maintaining a night light in his place of business and at the same time complying with blackout regulations was solved by a Schenectady machine-shop owner by means of a G-E photo tube, or "electric eye." Rules required that all lights be extinguished within five minutes of an air-raid warning. That meant either hiring a watchman or turning out all lights at closing time.

The first night that the lights were turned out, the shop was broken into. So the owner, Andrew Tessier, put the "electric eye" to work. He installed the tube in an upstairs window, pointing at the nearest street light. When, during a practice blackout or raid warning, the street light is extinguished, the tube immediately turns out all lights in the shop. When the street lights go on again, so do the night lights. The "eye" provides a watchman who doesn't go to sleep on his job, and whose total cost is about two weeks' pay for an actual watchman.

MOLECULES MARCH!

WITH the increasing use of plastics and of artificial silk and rubber in defense activities, the structural qualities of the molecules that make up these materials is all-important to the scientists who are doing the research work.

Dr. Raymond M. Fuoss, of the General Electric Research Laboratory, in Schenectady, has found that some molecules wiggle like worms when an alternating electric field is applied to them. Such molecules are electrically lopsided, and when in an electric field they tend to line up, just as compass needles line up with the magnetic field of the earth.

From this tendency of the molecules to move to and fro in an electric field, scientists are able to determine how the various molecules are built. With this information, new molecules can be designed to meet specific needs. Since artificial silk and rubber and many plastics are composed of these worm-like molecules which react in an electrical field, materials of a wide variety of properties may be expected as a result of these researches.

NOT FOR WILLIE—

THE General Electric Company is proud of the variety of services it renders its customers. Nevertheless, company officials were surprised by one recent request from a woman who had seen a G-E advertisement in a magazine.

The illustration in the advertisement contained a picture of a young boy. The woman also had a boy, and her boy looked very much like the boy in the photograph.

Mother and son had only recently moved to New York. Since then, she had taken her son to a number of different barbers, but none of them had produced a haircut that suited her. And so, in desperation, she wrote to General Electric to find where the boy in the advertisement had his hair cut. It was just the type of cut she had vainly tried to get.

GENERAL ELECTRIC

958-34-211

ILLINOIS TECHNOGRAPH

APRIL
1942

★

Firth of Forth Bridge

License Plate Study

Ceramic Ruckus

Illinois Research

Engineer's Day

Technocracked

★

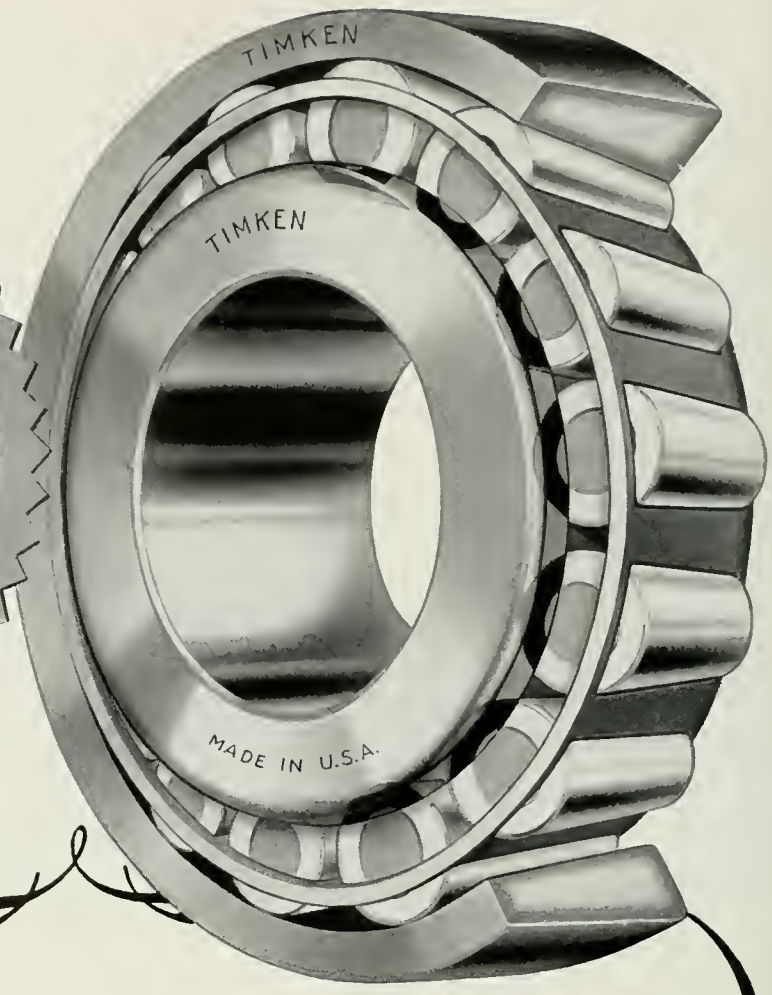
Left: Battery of Eyes for the United States Army.

—Courtesy General Electric

ished 1885 Member E.C.M.A.

20¢

TIMKEN BEARINGS are helping engineers to design for Victory. They will help them to plan for prosperity when the war is over.



Engineers responsible for the design of American mechanized armament and the machines that make it have found that they can successfully meet every bearing requirement with one kind of bearing—the Timken Tapered Roller Bearing.

Friction elimination; precision; radial, thrust and combined load capacities; maintenance of alignment of shafts and gears; all of these qualities are inherent in the design and construction of the Timken Bearing.

You never may be called upon to design military equipment, but a thorough knowledge of the Timken Bearing and its universal application will be one of your most valuable assets no matter what branch of mechanical engineering you eventually may enter.

We always will be glad to give you any information you may require —including the solution of specific bearing problems.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

Manufacturers of Timken Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; Timken Alloy Steels and Carbon and Alloy Seamless Tubing; and Timken Rock Bits.

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

It Pays To KNOW About ZINC

In the period of America's greatest industrial development, ZINC rendered indispensable service; it is reasonable to expect that it will be utilized even more extensively in the greater developments yet to come.

ZINC has now gone to war, as an essential element in every form of fighting equipment, on land and sea, and in the air. In times of peace, it is used in an almost infinite variety of applications, from the tiny elements of zipper closures to protective coatings for the hulls of the largest ocean-going ships. You can't get away from it—ZINC comes into intimate touch with the life of every individual.

The Zinc industry itself is earnestly and wholeheartedly striving to do a worthy job in supporting the nation's war program. It is also anticipating and preparing for the day when Victory is won, when new problems must be solved.

Are You, Too, Looking To The Future?

Will you be prepared with the knowledge you must have to solve the problems of the future?

ZINC is a material that it pays to KNOW about. You can get some interesting and very valuable data from these booklets, which will be sent to you free:

"The Zinc Industry"
"More Facts About Zinc"
Better write for them now.

AMERICAN ZINC INSTITUTE

Incorporated

60 East 42nd Street **New York, N. Y.**

Courtesy General Elec

WE WILL WIN! ★ ★ ★

Clouds of Airplanes and a Two Ocean Navy

This generation as our fathers and forefathers, has a duty to preserve a freedom earned through sacrifice by General Washington and the Continental Army. Many enemies of democracy have attempted to crush the tide of Americanism that rises to engulf them in attacks upon our shores and our government.

General Santa Anna didn't stem the tide with the attack on the Alamo. The Barbary pirates demanded tribute, but Lieutenant Stephan Decatur carried the fight to the tyrants and won. Sinking the U.S.S. Maine gave us Dewey at Manilla to allow liberty to flow unrestrained by the dam of aggression. An A.E.F. under General Pershing set "The Terrible Hun" back twenty years. All these events are the high water marks of the tide.

The treachery at Pearl Harbor gave us General MacArthur and the heroes of Bataan to mark the rise again. Remember Bunker Hill and Valley Forge—Barbary and the Maine—the Luisitania and Meuse Argonne—Pearl Harbor and Bataan and we will win.

WGM

Colossus of Steel and Stone

By Robert E. McCleary

Junior in Mechanical Engineering

A glance at the map of the British Isles shows Scotland to be almost cut in two by the firths of Clyde and Forth. These firths are similar to the Severn and Thames estuaries which similarly interrupt direct natural communication with the southern and midland portions of England.

Prior to 1890, travelers from Edinburgh to the counties of Fife and Perth had to choose between an inconvenient and often stormy passage of the Forth in a steamer at Queensferry, and making a long detour by rail around by Stirling.

These difficulties became intolerable and as early as 1805 a proposal was made to construct a double tunnel under the bed of the Forth. Matters got nowhere, however.

In 1818 James Anderson, an engineer whose ideas superseded the engineering science of the period, proposed a bridge at Queensferry which was to contain main spans of 1500 and 2000 feet with a 33 foot width. The cost was to be a mere $100,000. A survey of his plans show it to the benefit of any would-be stockholders that the scheme failed to pass the paper stage.

In 1873, the Forth Bridge Company made a start with subscribed funds to carry out Sir Thomas Bouch's plans for a two span suspension bridge of 1600 foot lengths each. A start was made for tower foundations on Inchgarvie Island, but the Tay Bridge, engineered by Sir Thomas Bouch, collapsed in disaster in 1879, and the work stopped, for he lost the confidence of the company and public.

Engineers confronted with the problem of maintaining both road and river traffic, as in this case, had recourse to several paths of action, i.e.:

1. A low-level bridge, with openings for vessels.
2. A high level bridge, with inclined road approaches.
3. A high level bridge with hydraulic lifts at each end.
4. A tunnel under the river with inclined approaches.
5. A tunnel with hydraulic lifts at each end.
6. A ferry.

Engineers toyed with plans submitted for a Thames estuary bridge which called for a rolling platform 300 feet long and 100 feet wide to be propelled from shore to shore on rollers placed on top of a series of piers 100 feet apart. Two point bearing would be assured and it was calculated the device would carry 100 vehicles and 1400 passengers per each 3 minute trip.

Since the conditions decreed that the points of support must be few and far apart, Messrs. Fowler and Baker, in 1881, submitted plans for a cantilever bridge of unprecedented size to bridge the distance between North and South Queensferry. These plans were adopted.

Let us explain the cantilever principle. Men seated in two chairs represent the towers and bases of a cantilever bridge. Both extend their arms simultaneously. Small downward pressures would easily depress their hands, so they are provided with sticks to grasp whose ends rest against the chair seats. Now their arms resist tension and the sticks resist compression. If the gap remaining between the mens' hands is bridged with a loaded plank, the men tend to lose balance and fall inward. If the weights are placed on the outside arms and the loaded plank is placed between the men and resting on the sticks, equilibrium and strength have been achieved. This is the cantilever principle.

The engineers erected three huge steel towers, each resting on massive piers at the extremity of the North Queensferry promontory, the western end of Incharvie Island, and in shallow water on the south edge of the south channel. Each tower is 361 feet above high water level.

From these huge supports six cantilevers were built out, each 680 feet in length. Those at the north and south ends are anchored to viaducts which carry the main roadway, 157 feet above high water, to higher ground. The other two pairs terminate while yet 350 feet apart, and these intervals are bridged by two girders resting on the cantilever ends.

Viewed sideways, the four vertical columns composing a tower are parallel, but when seen from the railway track a decided taper is noticed. This 'batter' of 1 in 7½, which contracts the towers from 120 feet apart at bottom to 33 feet at top, is maintained throughout the structure to the cantilever ends, where the height has shrunk from 330 to 34 feet and the width from 120 to 32 feet.

Inchgarvie tower is at a disadvantage with regard to 'live' or train loads. If two heavy trains pass one another

Above: The three cantilever towers in construction.
Below: The bridge was finally completed in 1890.

at an end of a cantilever, they exert a great pull on the central tower. The Fife and Queensferry towers are counterweighted on their landward ends by two huge boxes, each carrying 1000 tons of iron and resting on the viaduct piers. This was impossible in the Inchgarvie tower so this span was made 115 feet longer, the difference being between a pair of tower piers, which gave the columns farther from the live weight more leverage.

It is interesting to note the use of tubular construction in the lower compression members. These tubes are 12 feet in diameter in places and were curved by massive hydraulic rams. The upper tensile members are regular girder construction.

The problems presented to construction were enormous. Winds developing pressures of as high as 20 pounds per square foot often swept the firth. The great wind surface of the bridge would load the structure heavily under such conditions. The depths to which the caissons must be sunk for pier footing, were as much as 89 feet.

Each pier is of solid cylindrical concrete, 60 feet in diameter. Ten of the twelve piers were sunk by means of coffer dams or caissons. In deep water a pneumatic, closed-bottom section caisson was used, with workmen descending through air chambers to the bottom where pressures of 40 pounds per square inch made conditions very uncomfortable and dangerous. Electric lights, hydraulic spades and blasting was used to facilitate the sinking of these caissons into bed rock.

The first step in the actual construction was to fix the positions of the main circular piers. Direct chain or rope measurements were impossible, so the surveyors laid out a 4,000 foot base line on the south shore and there built an observatory for use in triangulating the distances.

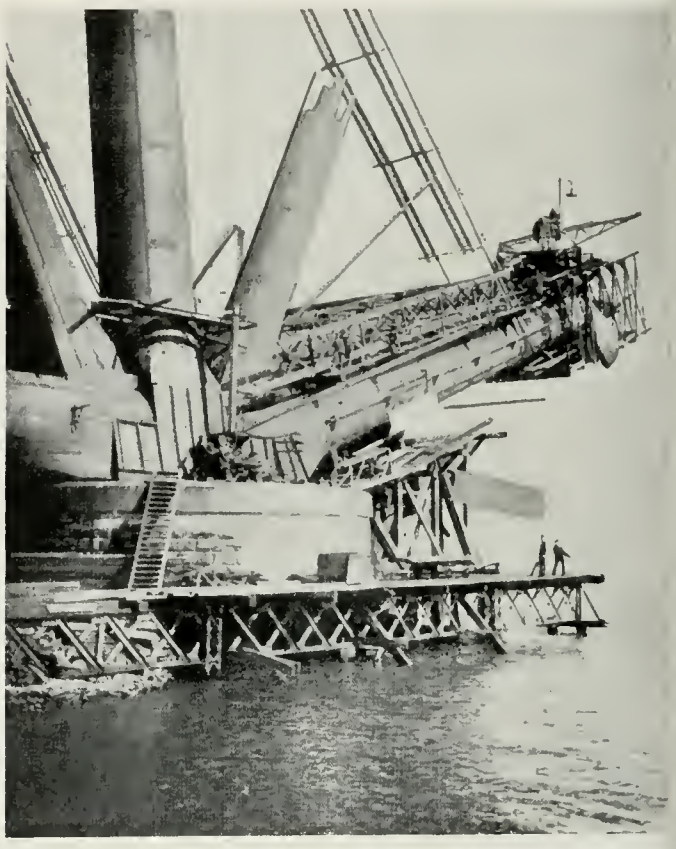
Shops for fitting the tubes, drilling, and patternmaking were erected, in addition to a sawmill and houses for an army of workmen numbering 4,600. A drawing loft where full sized drawings and templates were made on a blackened 200 x 60 foot floor, was built.

A water supply and facilities for handling and storing 140,000 cubic yards of masonry and 55,000 tons of steel were established. A cable for telephonic communication between various shops and offices crossed the bed of the Forth.

A jetty 50 foot wide and 2100 feet long extending from the south Queensferry shore to the Queensferry tower carried rails for convying material.

From 1883 until its opening to traffic in 1890, this colossal railway bridge cost over 15 millions of dollars. The 6,000,000 rivets would stretch 200 miles if placed end to end. Inside and out, its surface area of 145 acres requires painting once every 3 years.

A more detailed study of the history and of the obstacles faced and overcome in its construction, makes this early colossus of steel and stone an inspiration for any engineer.



View showing the tubular construction in the lower compression members.

Annual Highway and Surveying Short Courses Discuss Defense

By August Uttich
Freshman in Chemical Engineering

The twenty-ninth annual highway conference and the fifth annual surveying conference to be held at the University of Illinois had three hundred and seventy-five in attendance from March 3-6. Mr. W. W. Polk '81, who had just taken office as the Chief Highway Engineer of Illinois was introduced at the conferences.

The main discussions centered about the difficulties brought about by the war, and it was pointed out that since the war began many new demands have been made on the highway systems of the state. Road materials can no longer be easily obtained and the equipment for construction and repair is being greatly curtailed. Even the rubber shortage will have an effect on the highway conditions, if it is only to decrease revenue by decreasing the number of licensed vehicles.

Perhaps the most interesting discussion of the conference was one that advocated the building of the civilian defense units around the state highway units. Highway units are already sufficiently organized and their work on the roads and highways is inseparably connected with defense work. With these groups as a basis it would become much simpler to organize defense units.

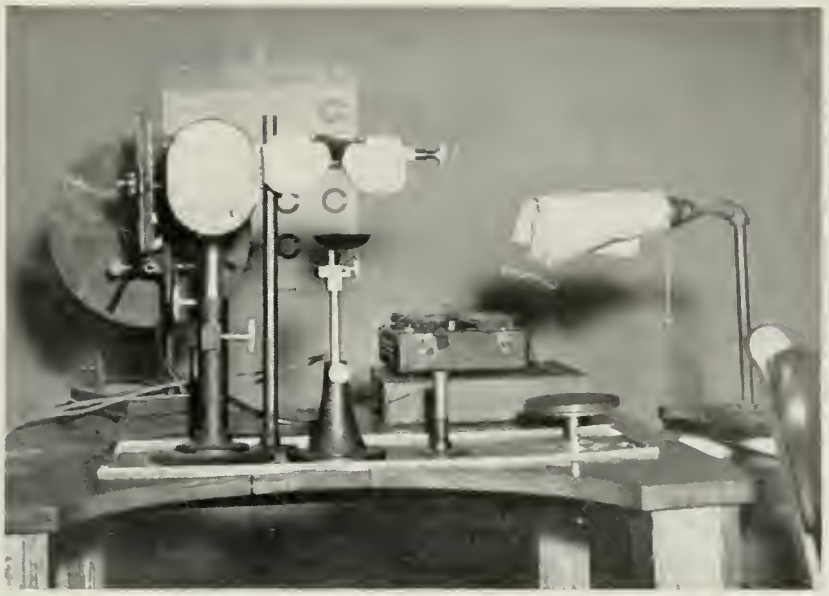
Many interesting papers presented at the twenty-eighth annual conference were available to those who attended the session this year. The Illinois Conference on highway engineering began twenty-nine years ago as a two weeks course on highway engineering. Gradually it has become a three day conference of all state and county highway officials, contractors, engineers, engineering facultymen, and the students of civil enginering.

President Arthur Cutts Willard was present at the surveying conference where the most interesting discussions centered around the progress and problems of the Chicago subway. President Willard was counseling engineer for the project.

Sound motion pictures showing the developments in the construction were presented. It was pointed out that, though the branches of the subway are not numerous or long, the present work is just a basis of the work planned for the future. Priorities for construction materails must be obtained to meet the needs of the further developments.

License Plate Color Study

By William G. Murphy
Junior in Civil Engineering



Apparatus used by Damascke showing similar "C" chart.

Mr. C. T. Damascke '41 won the district contest of the AIEE for papers written by undergraduate students in the Great Lakes Area, according to word received by Prof. E. B. Paine, head of the Department of Electrical Engineering. Damascke's paper will go from the district, which included all the Big Ten schools and many other engineering colleges in the North Central area, to the national contest sponsored by the electrical professional society.

The paper by Damasck was an analysis of the effectiveness of highway signs and license plates with the tests being made based on two main factors; namely, legibility and attention value. Many law breakers escape punishment every year because of poor legibility due to the color combinations and the numbers being poorly arranged with respect to glance legibility.

The technique of measuring the legibility involved the use of a universal sign board with racks in which the letters could be placed. A shutter device consisting of a venetian

Brightness meter used in color study.

blind with the slats mounted vertically to control the time of visibility was used for the experiments.

Studies made on the subject have led to the following conclusions on glance legibility:

1. Glance legibility distance was slightly less than the pure legibility distance.
2. Symbols derived their advantage from simplicity of layout and familiarity value.
3. Not more than three or, at the most, four words are seen at a simple glance, therefore symbols or words should be limited to this number on signs.
4. Attention value depends on color, contrast, relative size, simplicity, and contrast of layout.
5. Factors expected to be fundamental for priority value were: reading habits, position, and proximity to another attention compelling sign or object.

Equipment used in the brightness and visibility tests consisted of a visibility meter designed by Matthew Luchiesh and Frank Moss and a brightness meter of the portable type resembling a motion picture camera.

The visibility meter looks like a pair of eye glasses and is worn as such. It reads in both foot candles and relative visibility. The visibility was relative to the number of readings taken and the accuracy of the reading.

Due to the wide range of contrast and the limited range of the visibility meter, it was necessary to find by experiment the correct brightness to permit measurements during the entire experiment. The brightness was constant at 22-ft. candles.

Accuracy with the brightness meter came only through experience and the results were given in foot candles and foot lamberts. The lighting equipment included a bank of 16-60 watt incandescent lamps. Each had a reflector, and each lamp could be controlled by an individual switch. It was necessary to regulate the voltage to attain daylight brightness. The average was about 135 volts.

The test objects consisted of 31 separate colored plates 6x6 with the international "C" to match each color.

A test was necessary to find if there was a relationship between distance and relative visibility readings. Three sets of readings were taken and a ratio of the distance over the relative visibility was taken. The average distance divided by the average relative distance = 1.62 (in all cases).

The method of color classification used was the Munsell method of classifying by visual matching.

Old gentleman, bewildered at elaborate wedding: "Are you the bridegroom?"

Young man: "No sir, I was eliminated in the semi-finals."

APRIL EDITORS

This April issue of *The Technograph* was edited by William G. Murphy '43 and Sheldon J. Leavitt '43½.

The *Ceramic Ruckus* of 1942

By Donald K. Stevens
Senior in Ceramic Engineering

Running true to form, the ceramists had the most unusual dance programs of the year at "Ruckus" Saturday night, March 7. This group has not been satisfied with having the *only* departmental dance on the campus, but by having typical ceramic products as parts of the program they really are achieving a distinctive reputation.

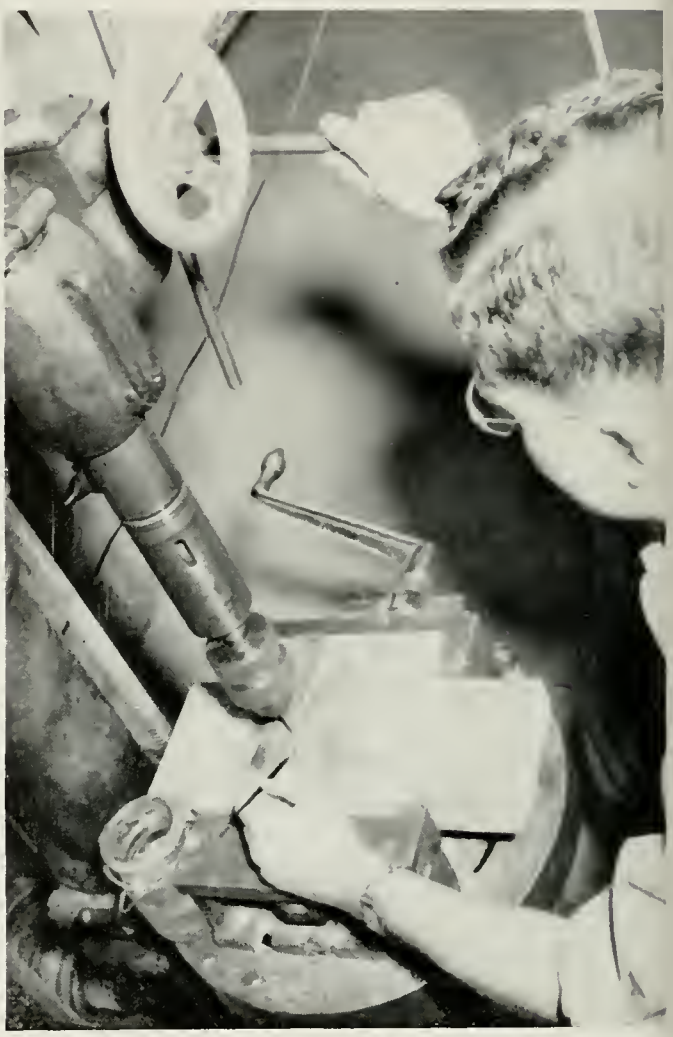
In the past enamelled ash trays, enamelled plaques, glass cloth, and attached miniature drain tile have been used as programs. The 1942 Ruckus programs were of blue flashed and white glass plates, with orange lettering fired on the blue glass.

The manufacture of the programs was in itself a difficult job. The glass plates had to be perforated and fitted together with metal rings. The edges of the plates are ground and beveled.

The lettering for the front cover was done by Mr. Axel Ottoson of the Ceramic Department faculty who also served as advisor to the students making the programs. By a photographic process this lettering was transferred to a gelatinized screen and by brushing ceramic color through the screen the exact reproduction was achieved. The plates were fired to mature the color and fuse it permanently to the glass. The various steps in making the programs are illustrated. By co-operation with several commercial firms the otherwise expensive programs were made at rather moderate cost.

The Student Branch of the American Ceramic Society, of which Bob Grove is the president, is looking for a new and attractive program idea for the 1943 Ruckus. These fellows are actually hoping to better their '42 work!

Ceramists turn "Hep-cats" for "Ruckus."



Perforating the glass plates by drilling was a difficult operation. (Additional illustrations on the opposite page)

The Editors and Staff

of

The Technograph

Join the faculty and students of the

College of Engineering

in mourning the death of

Dr. Arthur Newell Talbot

Illinois Research —

Sound Motion Pictures Developed

By Hayward F. Talley

Freshman in Chemical Engineering

Each week millions of American people sit in magnificent theatres throughout the land and see their favorite actors and actresses perform upon the screen, and hear them speak in all the naturalness of the human voice. The facts of science which were accumulated for use in producing these pictures are many and their applications varied.

Long before the days of the silent movie, it was realized that if a form is passed before the eyes at the steady rate of thirty times a second the brain could not detect the tiny periods of its absence. Further experiments proved that if an object is moved in its position before the eyes thirty times a second its movement would appear constant to the average person.

With the discovery of celluloid and its application to photographic processes, the problem of movement reproductin by means of pictures was reduced to a mechanical one. In 1895, Edison was granted a patent on a movie camera and an apparatus for viewing the pictures synthetically. By 1901, further experiments had led to another patent on apparatus differing from the previous equipment in that the film was perforated on both edges by circular holes in which pins of a driving mechanism would engage. The film was thus drawn through a projector before a strong source of light, and the picture projected on a screen. This is quite like the general system used today.

Still not content, Edison and his associates began experiments on combining his recently perfected phonograph and the photographic equipment in an endeavor to produce sound movies. His efforts seemed fruitless, however, because of his inability to synchronize the voice with the picture. With the aid of other inventors, suitable synchronization equipment was perfected; only to become superceded by an entirely new system of sound recording.

In 1906-10 Lauste, Mrs. Von Madeler, and others invented theoretical methods for recording sound on and reproducing the sound from the picture film. Due to inaccuracy of sound recording or reproduction, this system could not be used commercially, and most movies of this period were of the familiar "silent" type.

About 1920, J. T. Tykonciner of the University of Illinois Electrical engineering staff took up the cause of the sound-on-film movie. In June, 1922, he obtained patents on a perfected sound-on-film system and improved transmitter or "microphone." This system was proved thoroughly practical and silent movies were gone forever.

How It Works

Although there are two practical methods of recording sound on film, a reproducer capable of reproducing sound from one is equally capable or reproducing from the other. The two methods of recording on film are (1) the variable area method and (2) the variable density method.

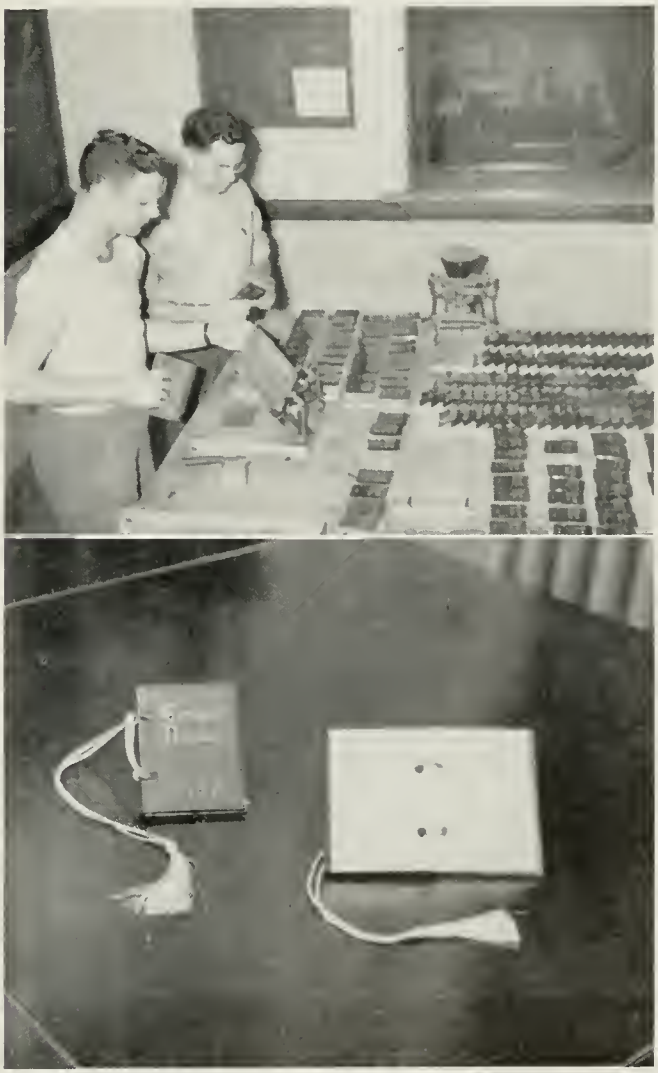
The variable area method consists of a source of light, a mirror, a suitable optical system for concentrating the light into a very fine beam. The mirror is supported by a loop of wire. This wire is connected in a circuit with the microphone which picks up the sound. As the sound varies the mirror reflects light over varying portions of the ground track on the film. When the film is developed the part of the film which was exposed to the light beam will be opaque while the remainder of the sound track will be transparent.

The variable density method consists of a variable intensity light source and a light valve. The light varies with the amplified sound currents and shines through a slit onto the moving film which is kept at a constant speed of 90 feet per minute. When the film is developed the sound track is covered with horizontal lines of various density.

The method of reproducing the sound consists of a photoelectric cell which varies in resistance with the amount of light which falls upon it. This cell is acted upon through the sound track of the film. The cell is connected in a high impedance circuit with an amplifier which reproduces accurately the sound which is picked up by the microphone during movie production.

Thus we see that Illinois, through the inventive genius of its engineering faculty, has scored again—this time presenting to the American people a most enjoyable means of entertainment and a most effective means of visual education.

Below: Bob Grove and Bob Forth stenciled the glass.

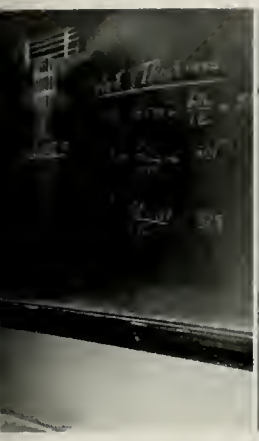


Above: The most elaborate and unusual dance programs on the campus.

A Day in the Li

By Donald K.

Men's Dorm has a never-fail alarm clock if you would believe Bill Murphy as he pours refreshing waters on unsuspecting Sterling Snyder at about 7:00 a. m. . . . It must be effective for that lad brushing his teeth is none other than I. Stirling Snyder himself, son of a civil engineer in Ripley, Tennessee. . . . Upholding his family tradition, "Colonel" forgoes breakfast and pulls a "Dagwood" as he dashes off to one of his five 8 o'clocks. . . . Bill has meanwhile donned his habitual uniform and has "one heck of a time" analyzing a simple girder for his C. E. 62 instructor. . . . And isn't it an engineer's luck to have to dash from "north of Green" to the Armory? Cadet Lt. William G. Murphy, Infantry, knows that Armory doorstep like his own home. . . Bill's roommate really eats, drinks, and sleeps civil engineering, so it isn't surprising we overhear him imitating Prof. T. C. Shedd's accent for the amusement of visitors in the A.S.C.E. office. . . . Checking up on the morning mail Sterling doesn't get any, but Bill's box is crowded as usual. It must take lots of girls at home to write enough letters to fill the Men's Dorm boxes! . . . Not taking



A Civil Engineer

Idon J. Leavitt

P. E., but trying to get in shape for the parachute troops (no kidding), "Colonel" and "General" may soon trade in their nicknames for titles of the same category, though not as glorious. . . . That deserves a good meal and time out to "chew the fat" too. Sterling, a southerner, eats slowly and Bill, from Decatur, Illinois but bearing the earmarks of his Pittsburgh background finishes only a little ahead. . . . Afternoon classes are drab events for the two juniors in C. E. but important nevertheless. Bill finds a little time for study this afternoon. The picture on his desk is that of Eunice McKee, home town girl going to Millikin University. . . . Even with slide rules hard to get you can't blame the fellows for "fencing" a bit. Ask them why, and even they don't know — probably just to relax the nerves. Bill's pipe isn't far away. Sterling doesn't smoke. . . And just to round out the day's activity dark haired Sterling and medium complexioned Bill entertain Janet Houston, Tri-Delt from Concord, Massachusetts and Eunice, also a Tri-Delt. Precise, slow talking Snyder tries to get the girls to see that the bending moment isn't really the instant at which the beam bends. It's all in the day for an engineer.

NAMES

. . . *in the news*

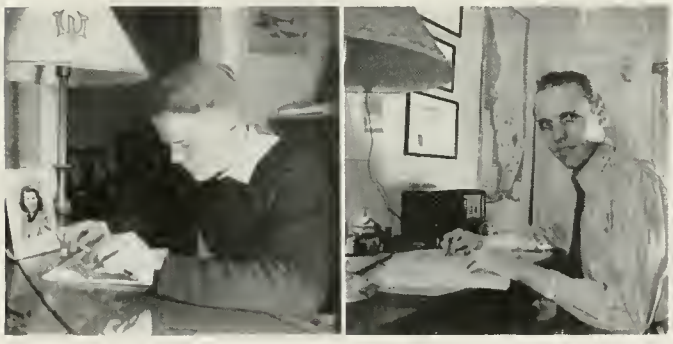
By William R. Schmitz

Freshman in Chemical Engineering

JOHN BOYD

John Boyd is a little man with big stuff. He is an Urbana boy and he has made good at Illinois. With a good 4.65 scholastic average, John is all set to joint Westinghouse this spring when he graduates. At the present, he doesn't know exactly what type of work he will do. However, he expects to enter the student graduate training program offered by Westinghouse. Here at the University, John has been working on a new type railroad car wheel. His object has been to find a new type wheel that will stand up under greater speeds. He is also quite interested in hydraulic turbines and fluid flow.

John is a member of A.S.M.E., A.S.T.M., Tau Beta Pi, Pi Tau Sigma, Sigma Tau, and Y.M.C.A. His chief hobbies are model airplane building and whittling. He has built and designed several gas model planes, and has won some contests. He is really quite an expert at whittling. He has on display at home a car of the future which he carved out of wood in 1937. Surprisingly enough, this



JOHN JACK

model is very similar to the present-day models. He also has some horses carved out of wood which are pretty good.

Last summer, John had a chance to visit M.I.T. and Harvard. One visit to each was enough to make him glad to get back to good old Illinois. He doesn't like the way they have everything crowded together, and their M.E. departments can't compare with Illinois. John has traveled around a good bit, working in the East one summer, on the West coast the next summer. John likes the West and hopes someday to live there.

JACK LENOIR

John Lenoir, better known to his friends as Jack, is a Chemical engineer extraordinary. Besides being a member of Phi Kappa Phi, Phi Lambda Upsilon, Tau Beta Pi, Sigma Xi, Sigma Tau, and A.I.Ch.E., Jack is one of the very few fellows on the campus who has a personal letter from Hedy Lamarr. If any of you skeptics doubt it, Jack has the letter hanging above his desk and is willing to show it to any and all.

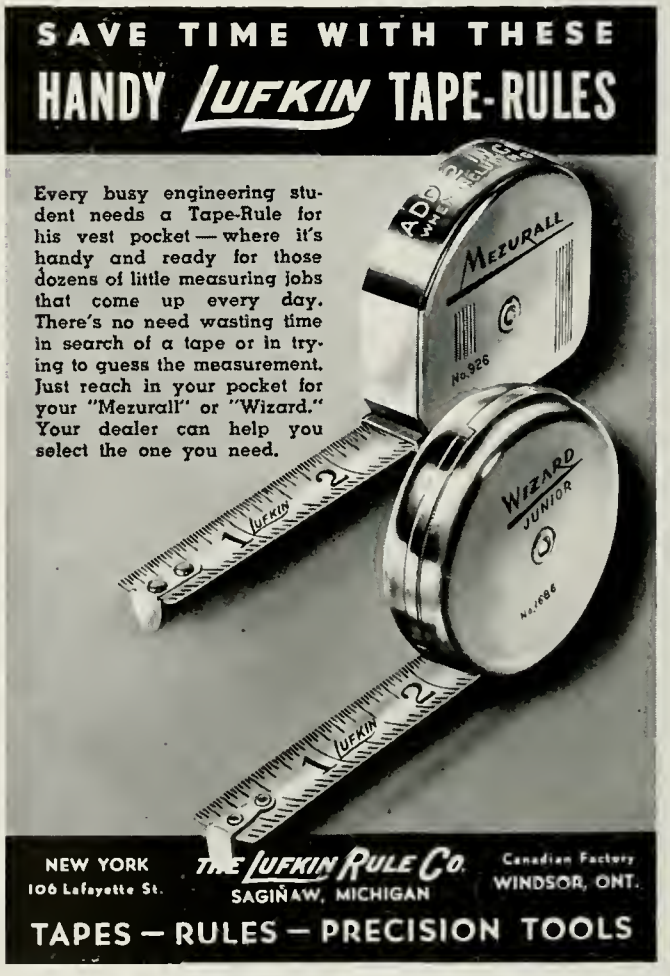
Jack spent his first year at Armour Institute before transferring to Illinois. Forced to drop out a year between his sophomore and junior year, Jack has come back to do a good job in his studies. When he entered school as a freshman, he wanted to be a great chemical engineer, but he now hopes to be only a good one. But from the 4.937 average that he is carrying around, we are inclined to believe that he will be a great chemical engineer. At any rate, Jack is all set to join the Westvaco Chlorine Products Corp. when he graduates this spring. He expects to be in the research department working on organic chemistry.

As you might guess, Jack's great love is organic chemistry. At the present time he is doing some research work on the polymerization of Styrene. Just the other day, Jack became the second person ever to make a certain compound. This compound is theoretically possible, but until Jack hit on the right combination, it had been made but once before. The chemical and physical properties of this compound are such that it is impossible to keep this compound more than a few minutes. Jack also spends a good portion of his time working in the rare-earths laboratory on the separation of some of the rare-earth elements.

Jack has some very interesting hobbies. He collects railroad time tables from various parts of the country. Besides being somewhat of an authority on historical events, especially the Civil War, Jack is also very interested in astronomy. He has a collection of maps, which he made, showing the positions of stars every two hours during the day. On top of this, Jack likes sports of all kinds.

OCD BULLETIN

You are enjoined not to disseminate reports of indeterminate provenance which have insufficient bases of authenticity, and which by repetition tend to acquire cumulative inexactitude. In other words don't spread rumors.



Lasher wins War on Weather!

For years, telephone cable has been hung by stiff wire rings from its supporting strand. But repeated expansion and contraction caused by temperature changes sometimes proved too much for even the best cable sheath. Fatigue cracks developed near the poles—this meant leaks—possible service interruptions—expensive repairs.

Recently, men of the Bell System developed a machine that lashes the cable and strand together in such a way that the concentration of strains near the poles is minimized. The Cable Lasher has also proved a great aid in the speedy installation of some of the new cables needed for airfields, camps, bases and war factories.

There are many opportunities in the Bell System for men with the urge—and the ability—to do a job better than it has ever been done before.

AMERICAN TELEPHONE & TELEGRAPH CO. AND ASSOCIATED COMPANIES — BELL SYSTEM

TECHNOCRACKED . . .

By Edward C. Tudor
Senior in Electrical Engineering

•

We would appreciate knowing who the jerk was that submitted the following:—

ODE TO A SCREWBALL

You try to be clever
And what do you get?
You're marked down forever
As strictly all wet.

You try to be witty
And what's the reward?
A few laughs of pity
In some minor chord.

You try to be humorous
But strive as you may,
The slams will be numerous
And they'll all come your way.

The moral is clear
If your life would be sunny
Don't try to be FUNNY!!!

As a come back, here is our offering:—

AN ENGINEER

Verily, I say unto you, marry not an engineer,
For the engineer is a strange being and possessed of many devils.
Yea, he speaketh eternally in parables, which he calleth "Formulae,"
And he weildeth a big stick which he calleth a slide rule, and he hath but one Bible—a handbook.
He talketh always of stresses and strains, and without end of thermodynamics.
He showeth always a serious aspect and seemeth not to know how to smile.
And he picketh his seat in the car by the springs therein, and not by the damsel beside him.
Neither does he know a waterfall, except for its power.
Nor the sunset, except that he must turn on the light,
Nor a damsel except for her specific heat.
Always he carrieth his books with him, and he entertaineth his maiden with steam tables.
Verily, though his damsel expecteth chocolates when he calleth, she openeth the package to disclose samples of iron ore.
Yea, he holdeth his damsel's hand, but only to measure the friction, and kisses but to test the viscocity.
For in his eyes shineth a far-away look which is neither love nor longing—but a vain attempt to recall a formula.
There is but one key dear to his heart, and that is the Tau Beta Pi key.
And one lone letter for which he yearneth, and that an "A."
Even as a young boy he pulleth a girl's hair to test its elasticity, but as a man he discovers different devices.
For he would count the vibrations of her heart strings and reckon her strength of materials.
For he seeketh ever to pursue the scientific investigations, even his heart flutterings he counteth as a vision of beauty and inscribeth his passion in a formula.
And his marriage is a simultaneous equation involving two unknowns and yielding diverse answers.

Gags of the month:—

Judge: "Are you positive that the defendant was drunk?"
Officer: "No doubt."
Judge: "Why are you so certain?"
Officer: "Well, I saw him put a penny in the patrol box on Green street, then look up at the clock on the Union

(*Please See Page* 18)

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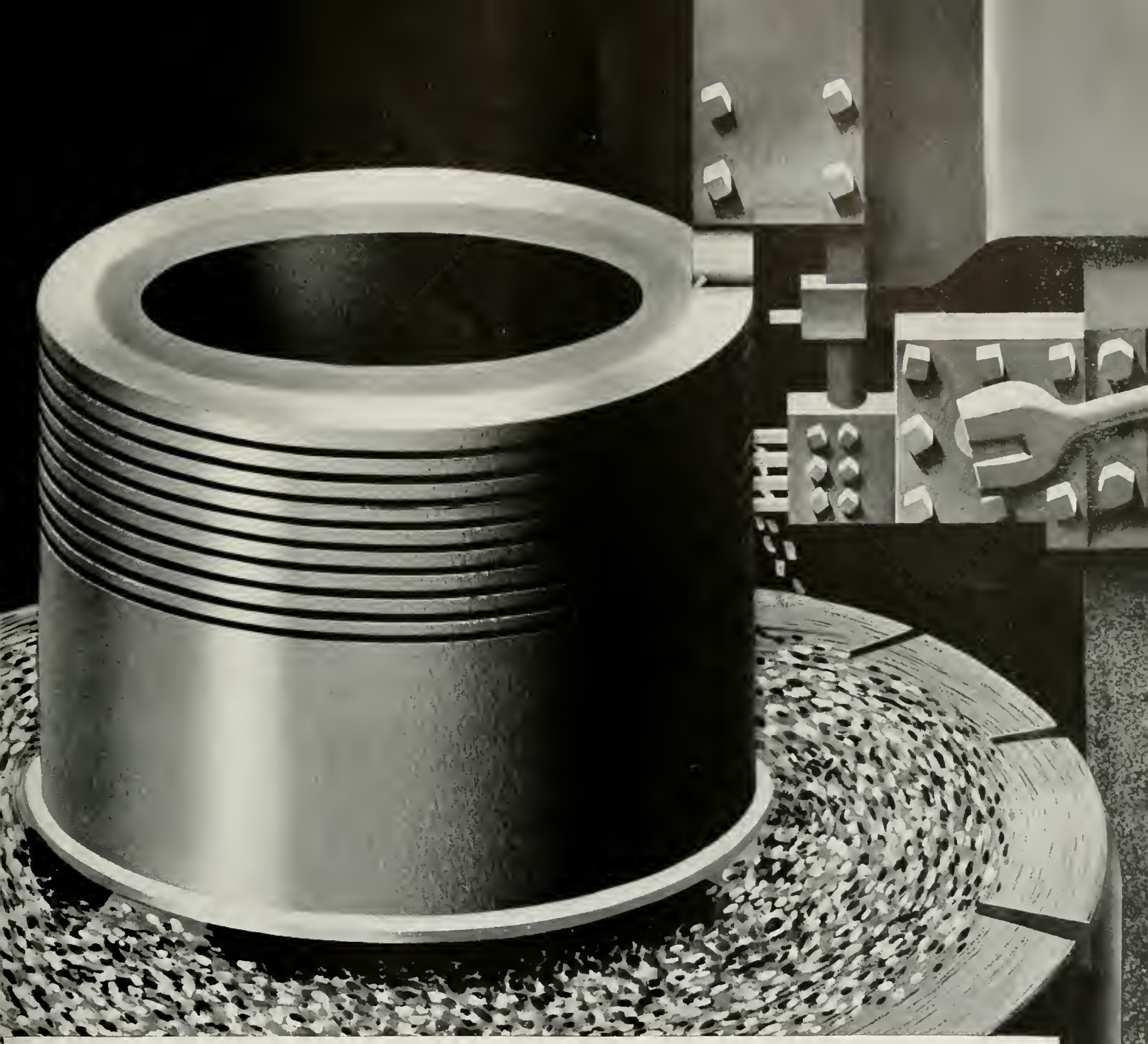

HOW TO SEE RED... AND LIKE IT!

Friction . . . arch enemy of *speed* in the machining of iron and steel . . . meets its match in cutting tools made of Haynes Stellite non-ferrous alloys. For these alloys . . . of cobalt, chromium, and tungsten . . . have the amazing property of "red hardness." Unlike cutting tools made of ordinary metals, they *keep their edge* . . . and keep on cutting . . . even when friction heats them *red hot.*

Making possible tougher, longer-lasting cutting tools is only one of the vital roles played by Haynes Stellite materials. Because they stand up under heat, abrasion, and corrosion, they are used to hard-face many different kinds of metal parts.

Oil well drilling bits . . . steam shovel bucket lips . . . heavy gears . . . shafts . . . airplane and truck exhaust valve seats . . . crusher blades . . . mixers . . . plowshares . . . and other pieces of equipment that must withstand steady punishment have their lives lengthened . . . and their efficiency stepped up . . . with welded-on hard-facings of Haynes Stellite alloys.

Use of Haynes Stellite alloys speeds up production . . . lowers production costs . . . saves on tool and part replacements . . . reduces time lost while replacements are being made. In the fabrication of new parts, base metals can be selected for such valuable properties as strength and ductility—without particular regard for wear-resistance—because they can then be armored against abrasion, heat, and corrosion by hard-facing with Haynes Stellite alloys.

Further savings can be made by the use of these alloys because worn parts can be *renewed*, instead of being sent to the scrap pile . . . thus eliminating replacement with materials hard to obtain.

Faster production . . . conservation of metals . . . lower costs . . . these are the contributions made to industry by Haynes Stellite alloys.

. . .

The development of Haynes Stellite Company alloys and hard-facing practice has been furthered by the metallurgical knowledge of Electro Metallurgical Company, by the research facilities of Union Carbide and Carbon Research Laboratories, Inc., and by the service organization of The Linde Air Products Company—which companies also are Units of Union Carbide and Carbon Corporation.

HAYNES STELLITE COMPANY

Unit of Union Carbide and Carbon Corporation

KOKOMO, INDIANA — NEW YORK, N. Y.

TECHNOCRACKED

(. . . *from page* 16)

building, and shout, 'Gosh, I've lost fourteen pounds'!"

"How much are these apples?"
"Fifteen cents a peck."
"What do you think I am, a bird?"

Tourist: "Milking the cow?"
Yokel: "Naw, just feeling her pulse."

Drunk (in telephone booth): "Number, hell! I want my peanuts!"

SLIP STICKING

The art of rubbing two twigs together and looking through a piece of rock with a line on it to get the wrong answer.

Spring has sprung
And I have sung
'Most split a lung
And swoll' my tongue
Your phone I've rung
I'm all unstrung
To me you've clung
My heart I've flung
My pin I've hung
If me you've strung
Your neck I'll wrung.

"So you're working your way through school? How do you do it?"

"Well, don't tell my father. He thinks I'm peddling liquor, but I'm really editing the humor magazine.

GTD

What is the Significance of this Mark?

FOR over 30 years this trademark has appeared on every screw threading tool and screw thread gage manufactured by Greenfield Tap And Die Corporation. Guess—if you do not know—its significance. Then turn this page upside down and see if your guess is correct.

GREENFIELD TAP AND DIE CORPORATION
GREENFIELD, MASS., U. S. A.

GTD GREENFIELD
TAPS · DIES · GAGES · TWIST DRILLS · REAMERS · SCREW PLATES · PIPE TOOLS

The outline of the trademark is the exact outline of a perfect "National Form" screw thread, walls, root, crest, etc. The letters are the company's initials. You can rely on threads cut by tools with this mark.

CLIPBOARDS 65c

•

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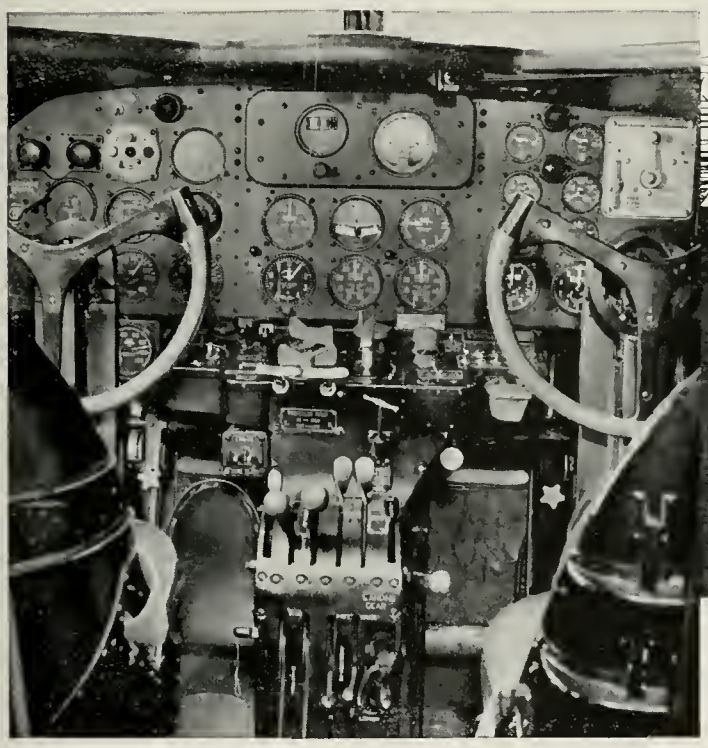
KAUFMAN'S
Are Famous For
CORRECT MILITARY UNIFORMS
for
U. S.
ARMY-AVIATION OR NAVAL
OFFICERS

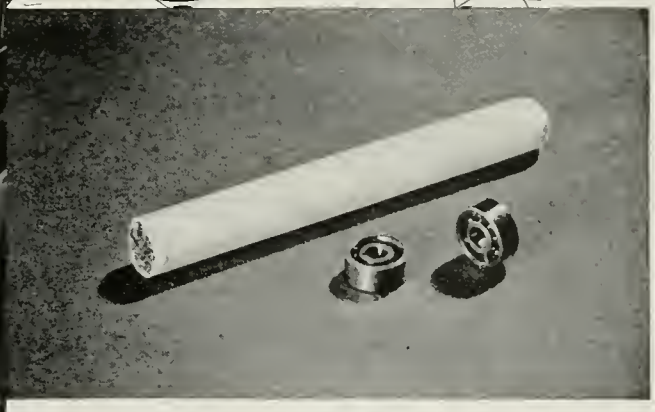
If you are subject to call, drop into Kaufman's uniform department any day and look over our fine showing of military uniforms for officers of the armed forces.

KAUFMAN'S
ON THE CAMPUS
AND RANTOUL

Determined Aves Crossaeum!

Determined to fly a true course instead of nothing but rolls and tailspins, the Aves Crossaeum (cross-eyed Floocus) finally overcame the handicap of Convergent Strabismus by developing a flight control independent of vision.





• Twelve New Departure aircraft instrument bearings like those above, end-to-end, equal the size of a slightly fat cigarette. Others you could hide under a match head. At left: Some of the instruments and controls in a twin-engined transport.

• That the determination of American Aircraft and Instrument makers to excel in their fields has been no figment of the imagination is attested by the fact that the quality and performance of America's swiftly growing air forces are second to none in the world. And in no small measure is this due to the superior qualities of the ball bearings used in the engines, controls and instruments.

New Departure, Division of General Motors, Bristol, Connecticut. Detroit, Chicago, Los Angeles, Seattle, New York and San Francisco.

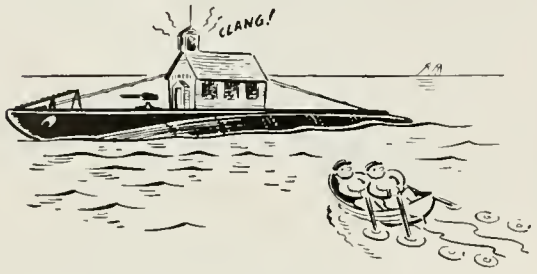
Nothing Rolls Like a Ball

New Departure
BALL BEARINGS

3083

G-E Campus News

NAVY CLASSROOM



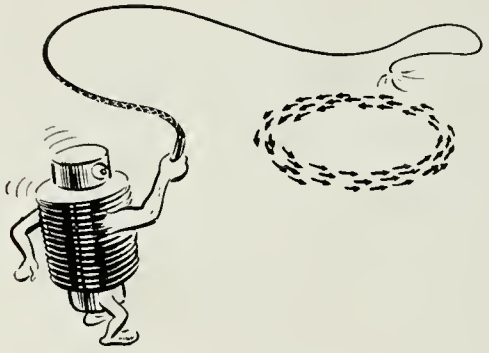
A U.S. submarine is essentially an electric-propelled vehicle, and an amazing amount of electric equipment is packed away in its steel hull. Responsibility for operation, maintenance, and repair of all this electric equipment is in the hands of two classes of petty officers – chief electrician's mates and electrician's mates first class.

For years General Electric has collaborated with the Navy in providing instruction for such men. They are shown how all kinds of equipment aboard their ships is built and assembled. Thus petty officers are better qualified both to care for electric propulsion and other apparatus in normal service and to repair it in case of emergency. This training has lately been accelerated. G-E plants are seldom without groups of these visiting Navy men, and in the past two years more than 50 petty officers have taken the "course."

100 TIMES TOO BRIGHT

IN the early days of electric lights, economical city fathers used to turn out the street lamps on nights when there was a full moon. For the best blackout techniques today, even moonlight is 100 times too bright. But although air-raid wardens can't do anything about the moon, for overcast nights General Electric's illuminating laboratory has developed a special street light which produces illumination about equal to starlight.

The fixture contains a 10-watt lamp, so concealed that the only light visible comes through a circular narrow piece of plastic around the side. A projecting black canopy screens the light from the eyes of aviators. The light output, equivalent to that from a single candle flame, seems at first sight to be practically zero. But after a little time eyes become adjusted, as they do in a movie theatre, and objects can be dimly seen 30 to 40 feet away. Specifications for the new lamp are based on the experience of the British in their blackouts.



ELECTRON WHIRLIGIG

WHETHER you call it a "rheotron" or "betatron" or by its longer name of "induction electron accelerator," a new science tool recently built by Dr. Donald W. Kerst in the G-E Research Laboratory is one of the world's most potent merry-go-rounds. On it, electrons ride to a speed closely approximating that of light – equivalent to that produced by 20 million volts. Copper bombarded by these dizzy, super-speed electrons becomes temporarily radioactive, and other interesting possibilities are being investigated.

Dr. Kerst, young professor at the University of Illinois, got the idea for the device, built a small model, and came to General Electric to build a bigger one. Like the much-publicized cyclotron, except that it accelerates electrons instead of positive ions, the device chases the charged particles round and round in a magnetic field, adding to their speed at every revolution. Scientists are reticent about predicting what the rheotron's chief use will be, but it is promising enough so that a bigger one is being built in the G-E laboratory for speeds of 100 million volts.

GENERAL ELECTRIC

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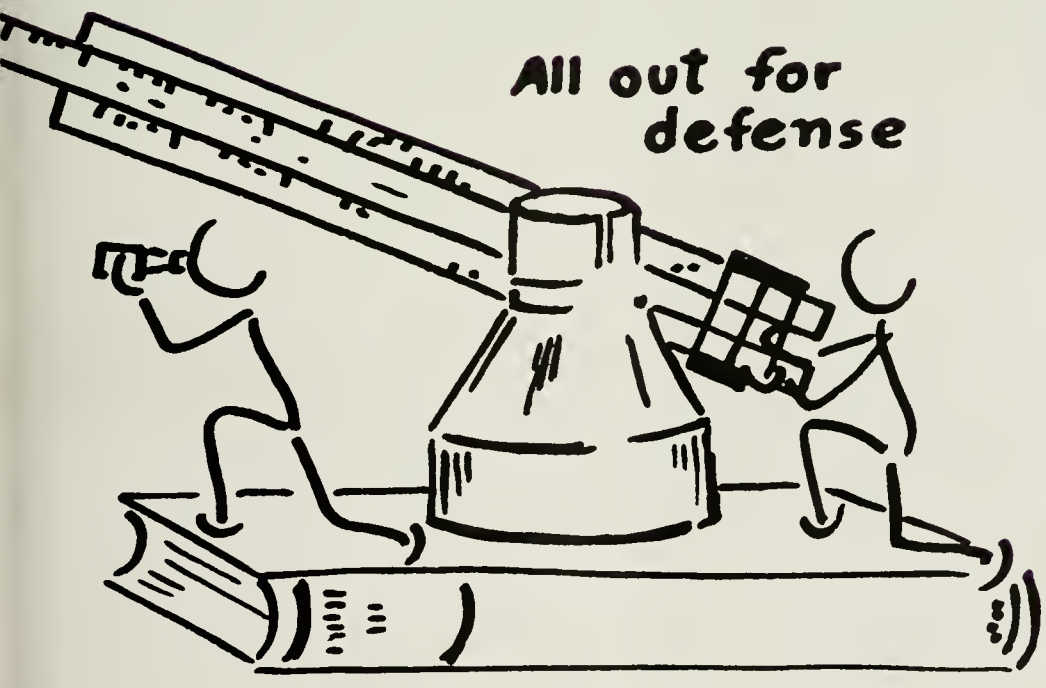

★

Steam vs. Hydro Power

Polaroid

Portable X-Rays

Mining Progress

Air-Conditioning

Technocracked

Naval School

ished 1885 Member E.C.M.A.

20¢

"TO PROVIDE FOR THE COMMON DEFENSE, TO PROMOTE THE GENERAL WELFARE"

Bad medicine for big bombers

ONE WAY to spoil a bomber's aim is to hang a curtain of steel over your ship and dare him to come down through it. To get that curtain of steel up there requires quick-firing, flexible guns.

To the plant of the Westinghouse Electric Elevator Company the Navy, a few months ago, brought its plans for such a gun. And to Westinghouse was given the important job of building the mounts that would control the aiming of these batteries of quick-firing guns.

And the Navy said, "Well done!"

Today, over the Westinghouse plant, there floats the Navy's "E" pennant—for excellence—eloquent testimony to the manner in which this Westinghouse plant performed the job. How was this plant able to get into growing production of these mounts so quickly? The answer lies in a Westinghouse characteristic called "know how"—the ability to get things done in the best possible way.

This Westinghouse "know how" makes itself felt wherever Westinghouse craftsmen build things. Whether for the common defense or the general welfare, this "know how" is doing a job. The same skill and ingenuity that made so many splendid things for peacetime living are now being applied to many important war weapons.

"Know how" will work for you again

We look forward to the day when we can give your home, your farm, or your factory the full benefit of Westinghouse "know how" again. To speed that day means just one thing to us: to produce, in ever increasing quantities, the tools with which to get the victory job done.

Proudly We Hail Our 600

• No group at Westinghouse has met its responsibilities in our war effort with more zeal and ingenuity than the 600 young engineers who only last year were your college mates. Already, their work in research and design has made vital contributions to our country's drive for victory.

This year, hundreds who are now college seniors will find at Westinghouse, as perhaps nowhere else, an opportunity to apply their schooling and intelligence toward winning the war.

Westinghouse

"An Engineer's Company," Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.

MAY ★ 1942

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Published Eight Times Yearly by the Students of the College of Engineering, University of Illinois

Published eight times during the year (October, November, December, January, February, March, April, and May) by The Illini Publishing Company. Entered as second class matter, October 30, 1921, at the post office of Urbana, Illinois. Office 213 Engineering Hall, Urbana, Illinois. Subscriptions, $1.00 per year. Single copy 20 cents.

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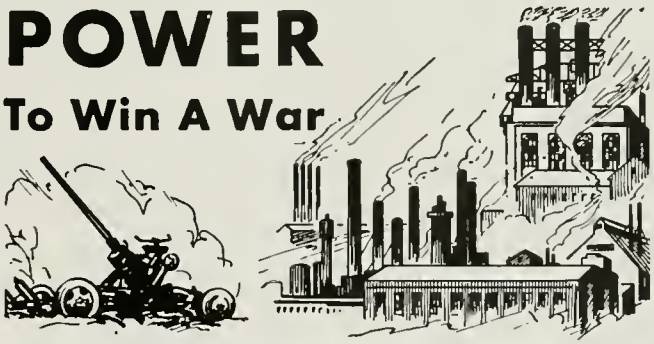
POWER
To Win A War



Behind the guns—behind the machines and the motors that drive them — is *steam,* "prime mover" of all industry. • Each time we find a way to squeeze an extra B.T.U. from a pound of coal or a gallon of oil, industrial output is accelerated and implements of war rush sooner to waiting hands at the front. Because B&W engineers have always been the first to originate major improvements in boilers, Babcock & Wilcox has become America's largest producer of steam generating equipment. • Today, all our efforts are devoted to helping utilities and industrial plants produce the power to win this war. In the victorious tomorrow, we shall stand ready to serve you whose hands will guide the future of American industry.

FREE 14-PAGE BOOKLET
"The Design Of Water-Tube Boiler Units." Not a manual of design, this interesting book explains what types of boilers are used for the most common types of service and why. Your copy will be sent on request.

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Victory for the United Nations in the war will, to a great extent, be a victory for American engineering and incidentally, for Timken Tapered Roller Bearings.

Many lessons will be learned from experience gained in designing war equipment and the machines that make it—lessons that you will profit by in future years when your student days are over and you are called upon to take an active part in the tremendous work of world reconstruction.

Among other things you will find—as thousands of experienced engineers already have proved—a thorough knowledge of Timken Bearings and their application as useful as your slip stick. It will enable you to meet every bearing requirement completely and soundly. We will be glad to help you with your bearing problems at any time.

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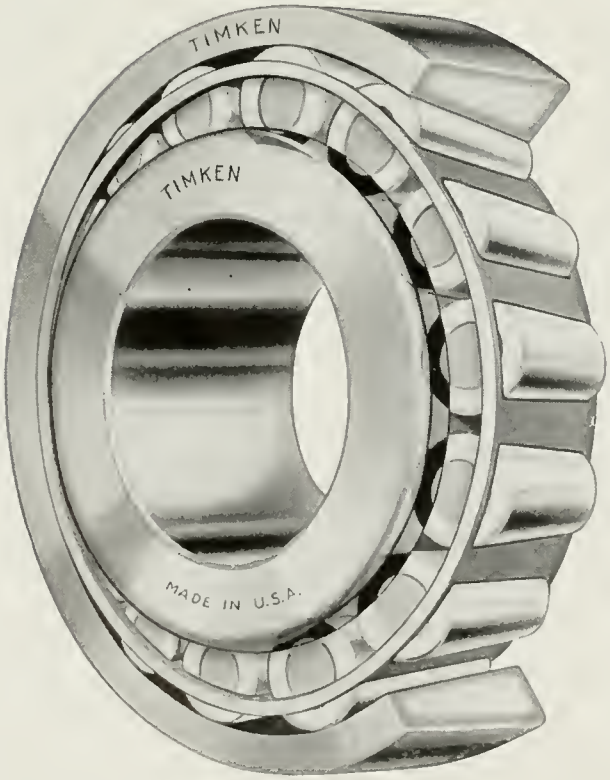

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Manufacturers of Timken Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; Timken Alloy Steels and Carbon and Alloy Seamless Tubing; and Timken Rock Bits.

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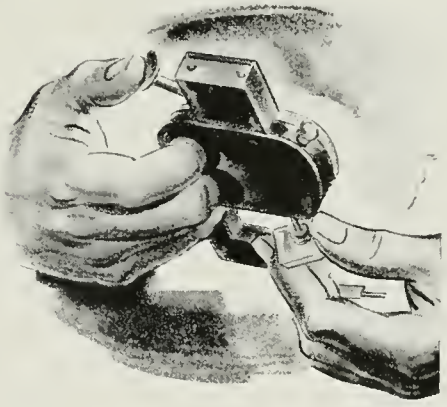
Doubletalk? No, it's how radio would sound if stations couldn't be kept on their assigned frequencies. The problem was licked once and for all when engineers discovered how to regulate radio frequencies with a tiny disc of quartz crystal, the thickness of which governs the length of the waves. Precision cutting, grinding and finishing of the quartz, a process Carborundum helped pioneer, makes today's accurate control possible.

No larger than a thumb nail, only about 1/16th inch thick, these oscillators must be finished to limits as close as 1/100th the diameter of a hair. With the aid of Carborundum Brand Abrasive Grains and Powders, the discs are made with optically flat and parallel surfaces, and thickness so accurate it must be measured in terms of light wave length.



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Before reading this article, which type of power generation would you think more economical? Mark your ballot, then read the story to check your decision.

Hydro-electric ..... ☐

Steam-electric ..... ☐

Combination hydro-steam-electric ..... ☐

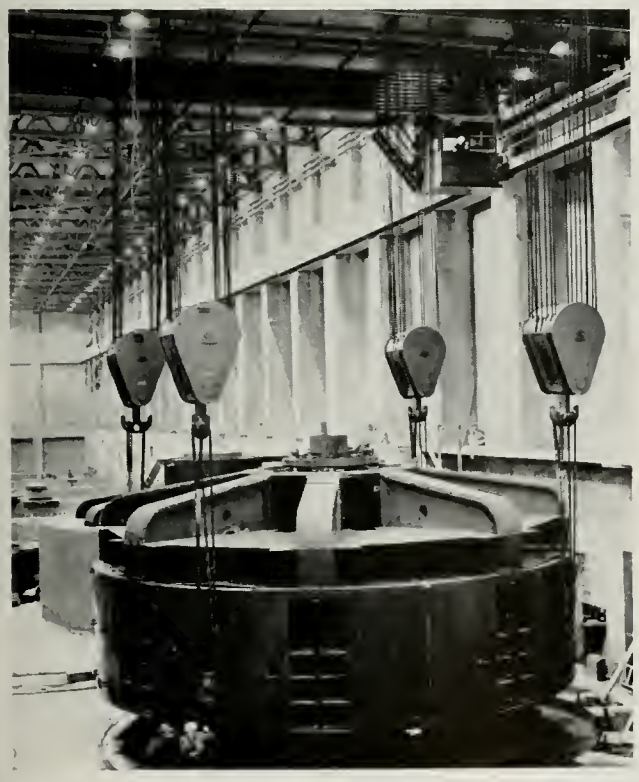
HYDRO *versus* STEAM POWER

By Donald K. Stevens

Senior in Ceramic Engineering

In connection with the War Effort new demands have been made on the already expanded electrical power supply facilities of this country. The need for more KVA's of power at a minimum expenditure in money and fuel has refocused attention on the discussion of relative merits of the hydro-electric and steam electric plants. The problem is: Which type of electrical generation is more economical —hydro or steam?

One factor in the discussion of a power plant is the efficiency of the actual turbine driving the AC generator. The extremely high efficiency of the hydro-turbine (94+%) exceeds that of the better type steam boiler-fed turbine (90+%) and it is in this respect that hydro-plants are often considered most efficient.



Above—Lowering second generator into place at one of two, million-kw. power-houses at one of largest government dams. (Courtesy of Westinghouse).

Left—Electrical power on the march.

Mighty Aswan Dam in Egypt generates hydropower.

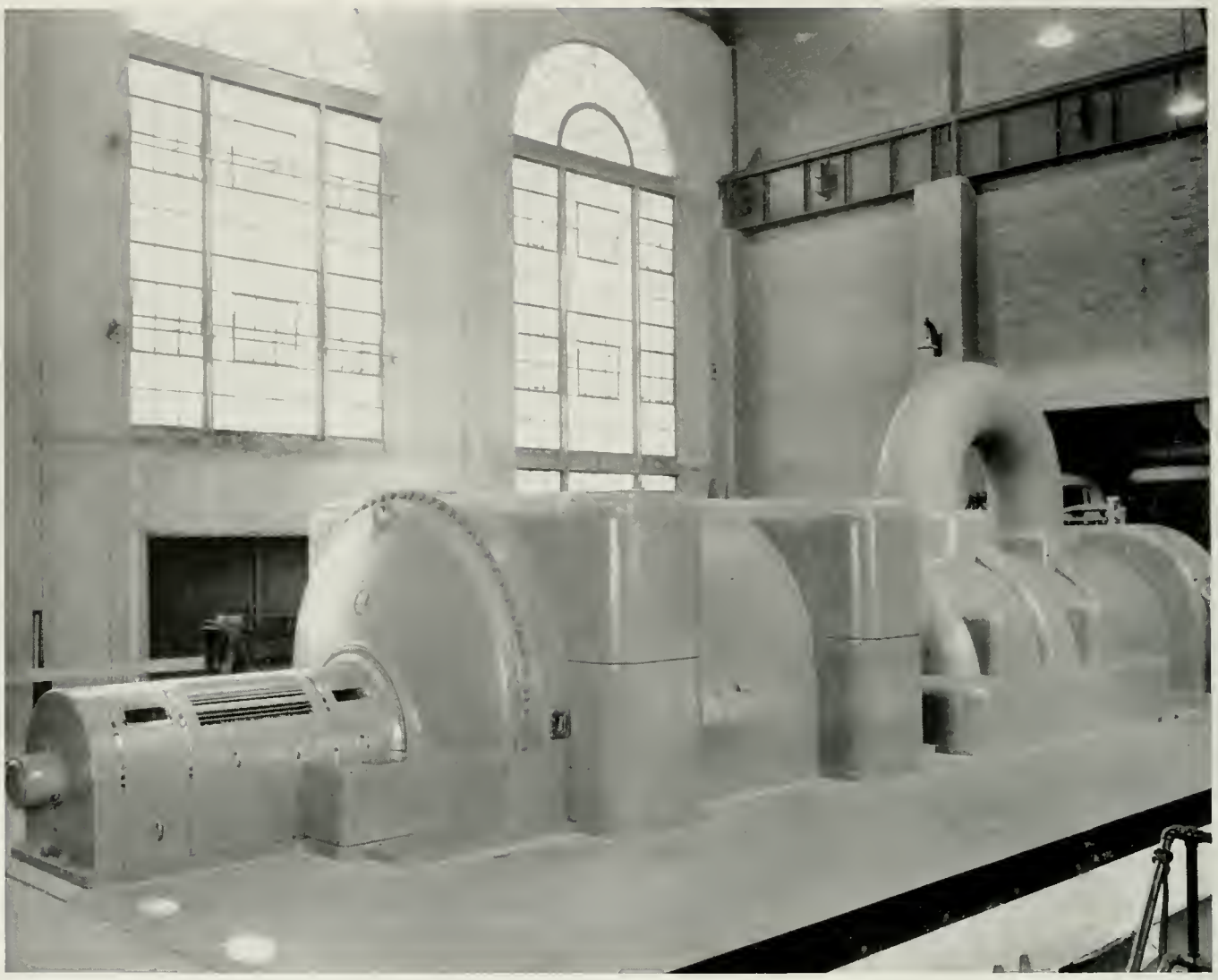
A second factor in comparing economies of operation is the cost of obtaining the impelling medium (fluid at high pressure) for the turbines. It is in this respect that steam plants jump ahead.

Following rapid improvements in boiler design the operating pressures in steam boilers jumped from 300 pounds per square inch with temperatures of 650 degrees Fahrenheit and a fuel requirement of 18,500 B.T.U. per kilowatt-hour of net station output (1918) to 1,400 pounds per square inch pressure, steam temperatures of 850 degrees Fahrenheit and a fuel requirement of only 12,500 B.T.U. per kilowatt-hour of net station output (1940). A kilowatt-hour can now be produced for about 9,000 B.T.U. (1942), utilizing both mercury vapor and steam. Improved water-cooled furnace wall design is greatly improving steam boiler efficiency. It is interesting to note that rate of evaporation of water per hour in a steam generator incrased from 60,000 pounds in 1910 to 300,000 in 1920 and to more than 1¼ million pounds in 1935.

The hydro plant requires a large volume of available water or a considerable head (or both, depending upon the demand) and this means a very large capital expenditure for a dam, penstocks, and equipment, and a reliable rainfall in almost all cases.

It has been estimated that the cost of power measured at the plant bus is 4 mills per kilowatt-hour for the steam and 6.3 mills per kilowatt-hour for the hydro-electric plant. Where the two types of power can be coordinated unit costs are reduced. Where the government has built dual-purpose dams for irrigation and power it is difficult to assign a definite proportion of the cost to its power-production potentialities. There is no doubt however that such structures as the Boulder Dam (see the cover pictures of January and March 1942 issues of *The Technograph*, Norris Dam, Pickwick Dam, Shoshone Dam and others will require many years of active power production to cover the capital investment therein. In each of these plants the equipment is remarkably efficient, but it is notable that none of theme are operating continuously at full capacity.

The ideal situation for hydro-electric power economy would be realized if, as in the case of Niagara Falls, large power consumers would be located near the point of power generation. Normally the best hydro-electric sites are found in the Northwest where the power demand is smaller than for corresponding areas in the East. In those places where



Sleek turbine-generator delivers 62,500 K.V.A. (max.) at Acme Station of Toledo Edison Co. (courtesy Westinghouse)

it has been possible to use hydro-electric power to handle peak loads and steam power for general use, in which the boilers may be kept on constant fire at full load themselves, power production has been very cheap and dependable.

Other factors in the general economy picture are the ever-increasing taxes (local, state, and federal), which are proportional to both the invested fixed cost and the operating income, and the cost of transmission and distribution of the electrical power generated. In the present taxation program ever higher levies are being imposed on utilities, but in 1934 taxes had already approached the cost of fuel in steam plants. Of the power dollar 38 cents go toward the cost of the generating plant, 24 cents to installation and upkeep of transmission ("hi-tension") lines, and 38 cents to the cost of local distribution systems. So far as the generating station itself is concerned it can probably be built for $75 to $125 per kilowatt of capacity, depending of course on size, location, type of prime mover, and design of the plant in general.

Tide-harnessing projects and other schemes at first seeming practical have been shown by experts to be less economical than either the steam or usual hydro-electric type of power plant. Diesel and gasoline internal combustion motors are gaining favor in small power units but are very uneconomical when compared to the turbine for large installations.

In the final consideration in every case one returns to the combined steam-electric augmented with a hydro-electric unit as most economical large production power generator. In communities where waterpower is not immediately available, or demand is not unusually large the steam turbine is the most economical means of producing electrical power.

NEW EROSION RESISTANT BEARINGS
Use "K" Monel Metal

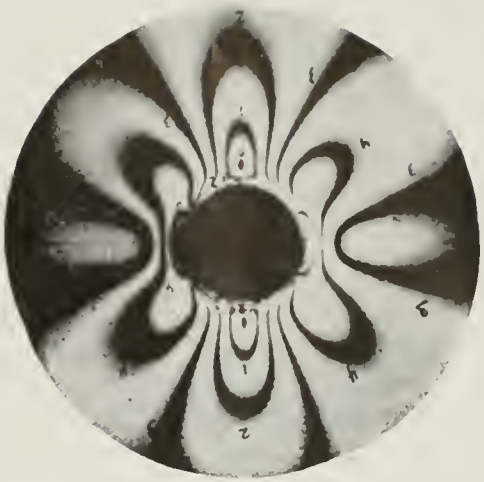
A new development now makes it possible to use ball and roller bearings in services involving exposure to many corrosive liquids and gases.

This nickel-copper alloy can be heat-treated to provide a hardness, wear-resistance and strength not ordinarily associated with non-ferrous bearing materials. Its resistance to corrosion is such that it can withstand the action of many acids, most alkalies and a wide range of gases. Furthermore, it retains high mechanical properties over a range from low sub-zero temperatures to above 800 degrees F. It is non-magnetic down to —110 degrees F.

Many uses already have been indicated for these new bearings in food handling equipment, chemical plants, motor boat service and elsewhere where it is not practical to protect ordinary bearings with housings or grease and where slight changes in design and increases in diameters over corrodible materials, are permissable.

Stress striations in loaded angle plate.

By
Robert McCleary
Junior in Mechanical Engineering



Stress about hole in loaded plate

POLAROID *is* VERSATILE

Polaroid is a transparent material that produces plane polarized light by simple transmission. It has the ability to discriminate among the many possible directions of transverse vibrations in a given beam of light and to transmit light that is vibrating only in on specified direction. Polaroid is chemically and mechanically stable, and easy to handle. It is manufactured exclusively by the Polaroid Corporation.

The phenomenon of polarized light has been known to science since 1669 when Erasmus Bartholinus observed the double refraction of Iceland Spar. In 1808 Malus accidentally discovered that some of the light of Luxembourg Palace in Paris was plane polarized.

Polaroid is manifold in use and it is believed that only a fraction of its useful field has been exploited.

Polaroid may be used to eliminate headlight glare. The headlights and windshields are made of Polaroid with polarizing axis inclined 45 degrees. A driver sees his own lights freely but his windshield blocks out direct light from an auto approaching from opposite direction. Needless to say, both vehicles must be Polaroid equipped.

Sun glasses of Polaroid greatly reduce glare from pavements, snow, sandy beaches and the sea. This is because most glare is reflected light which has become polarized horizontally. Vertical polarizing axis in the glasses with double adjustible lenses are now on the market.

When a sheet of doubly-refracting material, such as cellophane, cellulose tape, mica, etc., is put between two Polaroid sheets, a color filter is formed. The colors may be varied by rotating one sheet. This provides a new method for producing vivid advertising displays and for general illumination.

Stereoscopic vision arises from the slight differences in images received by each eye. A picture may be projected upon a screen with horizontally polarized light and a slightly different picture superimposed upon it with a projector of vertically polarized light. If the audience wears glasses with one vertically polarized lens and one horizontally polarized lens, the two different pictures are seen separately and a three dimensional effect is very pronounced.

In photography, a polarizing filter may eliminate certain highlights or reflections and preserve the detail over a wide range of densities.

Covering a lamp with a properly oriented piece of polaroid eliminates glare at source, leaving reflected light entirely diffuse.

Rock sections, crystals, textile fibres, etc., may be studied with ease under a Polaroid equipped microscope. Mineralogists, crystallographers, and colloid chemists find such a microscope their basic tool.

Perhaps to engineers the most important application of Polaroid is in the study of stressed test specimens. Associate Professor Thomas J. Dolan of the T.A.M. department of this school has devoted much time to his photoelastic laboratory where research in this field is being conducted.

The scope of this article is such that only the basic principles of this new and interesting visual study of stress concentration in stressed members can be enumerated.

Basically, photoelasticity is the phenomenon observed when a stressed specimen of transparent Celluloid, Bakelite, Catalin, Phenolite, Lucite, etc., is viewed from between two sheets of Polaroid with axis crossed. Such specimens when loaded become temporarily doubly-refracting, the refracting quality depending upon the magnitude of the stress at that point. Thus a mixture of colored bands is presented to the eye. The analysis of these striations makes possible a deduction of the nature of stresses and strains in the material.

The prime task of the photoelastic engineer is the preparation of uniform, highly transparent, unprestressed, specimens of often intricate forms and the correlation of the stress-strain patterns produced with a pair of coordinate axis. This task is no small one, although much progress has been made.

Particular interest is centered around localized stresses caused by such stress raisers as abrupt section changes, fillets and holes. The stresses about these points in a specimen may reach values several times as large as those in the main body. As a consequence of such localized stresses, crack lines and/or plastic flow will develop even under moderate loading. These stresses will cause premature failure under dynamic loads of sometimes only $\frac{1}{5}$ the ultimate strength of the material.

Three dimensional study of stresses in built-up (cemented) specimens of intricate form is also receiving much attention. The original studies were confined to two dimensional stress study of constant thickness plates, because of difficulties of machining without pre-stressing the material.

In this article are seen photoelastic pictures of two types of loaded specimens. Accurate vision, long study and experience are necessary for proper interpretation of the stresses and strains which are represented by these multi-colored bands. However, definite patterns are discernible, and changes in loading is very graphically impressed upon the eyes of any observer.

Photoelasticity provides an entirely new and interesting field of endeavor for those engineers who are ambitious and like T.A.M. courses.

Portable . . . High Voltage X-RAYS

☆

By August Uttich

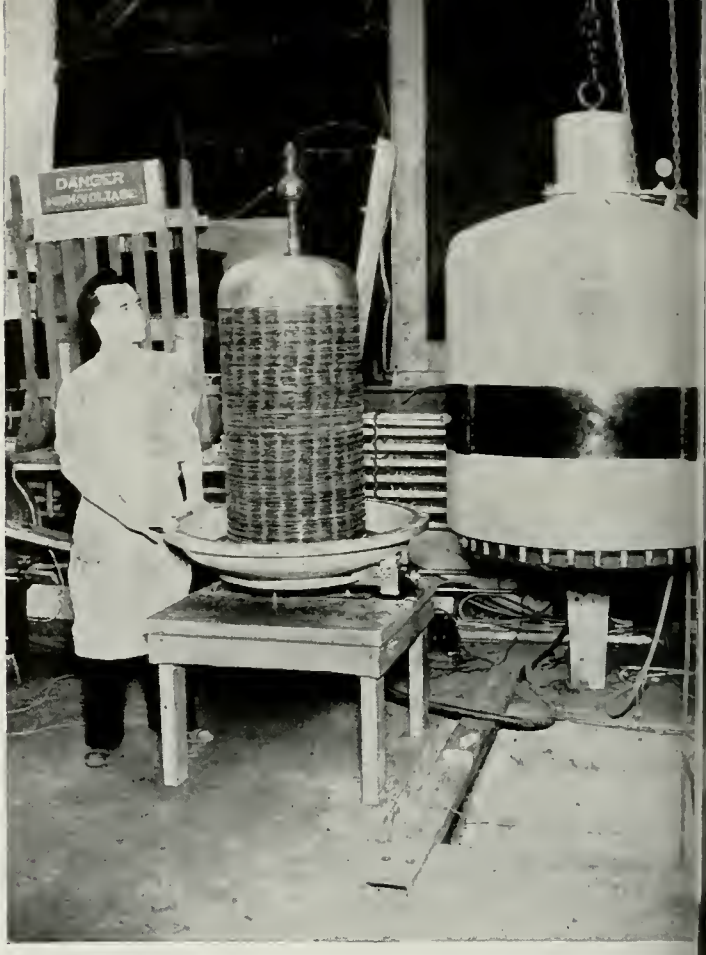
Freshman in Chemical Engineering

Largely through the efforts of an Illinois alumnus, Dr. E. E. Charlton, the General Electric research laboratory has developed a portable, million volt x-ray outfit. The new unit, which is a development of their high-voltage therapentic outfit, is greatly reduced in both size and weight so that it's moveability will be invaluable as a radiographic tool in the industrial examination of metal structures.

* * * *

In short the outfit consists of a low frequency resonance transformer mounted together with a sealed off, multi-section x-ray tube. These are contained in a steel tank and are insulated by compressed gas. The ex-rays are generated from the regular tungsten target mounted in the end of a chamber extending out of one end of the tank. The whole outfit is only three feet in diameter and four feet in length and weights but 1500 pounds.

Completed unit. (courtesy G.E.)



Transformer removed from steel tank. (courtesy G.

The transformer for the unit contains 238 miles of insulated wire consisting of a high voltage and a low voltage.. By means of what is known as the resonance principle, the usual iron core is eliminated, making way for the x-ray tube itself. This arrangement not only saves space but facilitates making the connections to the tube electrodes and eliminates electrostatic interference in the tube.

The lower end of the high voltage coil is grounded and the number of turns chosen for the winding is such as to make its natural frequency of oscillation 180 cycles per second. The 180-cycle power is derived from the 60-cycle supply line but an intermediary synchronous motor generator set renders operation independent of line-voltage fluctuations. The coil is held under compression by seven spring-loaded glass rods, which make it possible for the unit to be operated in any position.

Designed to go with the transformer is the novel x-ray tube. It contains the electron-emitting cathode and the copper-backed tungsten target but also has eleven accelerating electrodes of stainless steel spaced evenly along its length. These eleven sections and the cathode section are molded of borosilicate glass tubing joined to rings of fernico, a new alloy with the same coefficient of expansion as the gas. The inside glass walls of the tube envelope are sand-blasted. The chamber walls and target both are water cooled.

The tube is now evacuated and sealed. To insure stability of operation and long life all sections are aged at voltages 100 per cent higher than the operating voltage.

* * * *

The tank of the million-volt units is made of sheet steel one fourth of an inch thick, 36 inches in diameter, and 48 inches high, and has been tested hydrostatically to

200 lbs. per sq. in. By means of a rubber gasket the joint between the shell and bottom flanges is made gas-tight.

* * * *

The gas used to insulate the transformer from the tank is known commercially as Freon. It is odorless, nontoxic, non-inflammable and for all practical purposes inert. Before the gas is applied the tank is evaporated to a 28 in vacuum; then it is fllled with the Freon to 60 lbs. per sq. in. A pressure state of the main tank blocks operation of the transformer if the pressure drops below 50 lbs. per sq. in. either by leakage or due to low temperatures.

* * * *

This x-ray unit, which can operate continually at a million volts and a maximum current of 3.0 milli-amperes, produces very penetrating x-rays of high intensity. With this unit sections of steel ranging from 1 to 8 inches in thickness can be radiographed in short time exposures.

Radiographs taken with the unit will clearly define defects ranging from two percent down to less than one percent. Besides the speed advantage of the new outfit, it allows greater latitude in the range of metal thicknesses readable on one radiograph without the time consuming complication of the blocking technique used in the lower-voltage range. Likewise it permits greater target-film distances, still keeping the time of exposure down to seconds and minutes.

The unit is operated from a control panel on which is set time and intensity of exposure. All people are called out the x-ray room, which is well insulated by lead or concrete, and after a few pushes of buttons the radiograph is ready for inspection.

A few years ago x-rays were a baby science, but it has grown from that stage till with this latest innovation industry has received rays that can be moved with ease and projected through metal structures which vary greatly in size and wall thickness.

HEY, RED CAP!

Lives there a man since Davy Crockett,
Who hasn't had an evening bag in his pocket?
To the unwary it looks so tiny,
But it's made many men dive in the briny.
Into it she crams all her stuff,
Fifteen articles, plus a powder puff.
"Would you mind," she says with the sweetest smile.
That's started many on their last mile.
If she wants it once, it's at least five times,
To check it is a waste of dimes.
The longer you carry it, the heavier it seems,
Until it exceeds your very worst dreams,
And when the evening's over, and you give it back,
It's like returning a five pound sack.
It stretches your pockets, and ruins your clothes,
And why you do it, nobody knows.

Preparing to Radiograph thick-shell casting. (courtesy G.E.)

Progress *in* Metal Mining

By Hayward F. Talley
Freshman in Chemical Engineering

Hydraulicking with a 9-inch giant. (courtesy U. S. Bureau of Mines)

In after years, the present world conflict may well be known as the War of Metals. It is a war of resources and supplies. Because modern mechanized warfare is fought with metallic weapons and is carried on with the aid of metal constructed vehicles of transportation, our mines are a most vital front line of defense.

Then entry of the United States into the war has not caused radical changes in methods of mining. Rather, there has been a general improvement in mining practice and in unit production. Most of the changes have been at the larger mines where greater use of mechanical equipment in stopes has been made and a more rapid extraction of ore made possible.

In mines where the ore is loaded mechanically in the stope, as in breast stoping, the trend has been towards deeper rounds and larger blasts. Larger blasts are also considered effective in systems of open stoping where the ores fall into chutes. The increase in the size of the blast has been obtained by (1) increasing the size of the face and the depth of the round, (2) shooting two additional rounds between loading cycles, or (3) drilling longer holes as nearly parallel to the face as possible and utilizing heavier burdens.

In the past, a very serious problem has been that of ground support. As mining is carried to greater depths the effect of either not supporting or of improperly supporting the upper workings becomes cumulative; seriuos consequences such as rock bursts or crushes usually result. Today, where stopes with pillars between are used, the trend is to use narrower stopes rather than to see how large a span can be kept open. Hydraulic fillings of stopes offers excellent support, but disposing of the water drained from the filling may present quite a problem. By keeping about a foot of water above the top of the sand filling, it has been found that the sand filling distributes itself with surprising uniformity over the entire stope, maintaining a level that is practically horizontal.

Where the use of wet filling would be objectionable, there is rapidly opening a field for pneumatic stowing as is used abroad in coal mines. In typical tests made with pneumatic stowing, four inches of material was blown in at an effective range of twenty feet by a stream of compressed air under 65 to 80 pounds of pressure per square inch. About 2,500 cubic feet of air was consumed per cubic yard of filling.

As an example of the new types of mechanical equipment being used today, we shall consider the belt conveyor. It will handle wet and sticky ores, but is not suitable for course ores. The use of the belt conveyor for moving hard ore, except under unusual conditions, requires excessive secondary breakage in the stope. Belt conveyors have, however, one decided advantage over almost all other forms of transport in that they work with the same capacity on all slopes, both favorable and adverse, that do no exceed the angle of 22 dgrees dip.

In modern mine ventilation, which is so essential to allow workmen to perform their tasks efficiently, the axial

Coal conveyor unloads into electrically driven cars. (courtesy Westinghouse)

Slusher operating in sub-level caving drift, Newport mine, Ironwood, Mich. (courtesy U. S. Bureau of Mines)

Waste rock and copper ore hauled by largest locomotives in mining service, Morenci, Arizona. (courtesy Westinghouse)

flow or modified type of propeller fan is finding favor. Closer control is being paid to the quantity and quality of air being circulated in various parts of a mine. Unless the shafts were considered in planning the system of ventilation for a mine, the shafts may later prove to be the bottleneck in the circulation of air. Mine resistance may be reduced by increasing the area of the exhaust shafts where this is feasible.

In times of stress when production is pushed to the limit, it may be expected that the ratio of accidents to output would increase. This has not been the general rule, however. The situation has been handled in various ways in the mining industry. In some cases new men work on the surface until they feel at home and have shown the management what they can do. In other cases, classes of instruction are held. In one mine certain stopes are considered as training schools for new men, and accent is placed on safe production rather than the number of tons produced. There have been no acidents of the disaster type for well over a year. The disabilities and fatalities have involved individuals and small groups only at any one time. While this type of acident is not one that gains wide publicity, the sum total of them is impressive and disturbing. A constant safety effort in the mining industry is most essential to prevent an increase in accidents. A superior effort could mean that the mining industry need not retain its very low relative safety in relation to other industries.

These are but a few of the ways in which the mining industry is meeting the problems encountered when a nation at war calls for ever increasing amounts of the nation's natural resources. The Metal Mining industry is truly doing its part to insure that The War of Metals will terminate in our ultimate victory.

"Scorched Earth" Reseeded by Plane

By Edwin Thomasson, *Freshman in Mining Engineering*

Experiments in the western part of the United States recently have proven beyond a shadow of doubt that airplanes will be used to reclaim vast acres of land formerly impossible to seed. Burnt forests, inaccessable mountains, and wasted grazing lands may soon be blessed with green grass, providing new grazing lands and helping to check disastrous erosion and even more disastrous floods.

Planting by airplane is nothing new, although its application to such rugged terrain is. Cotton planters in the south have long used the airplane to dust their crops, thereby controlling the boll weevil.

(Please See Page 15)

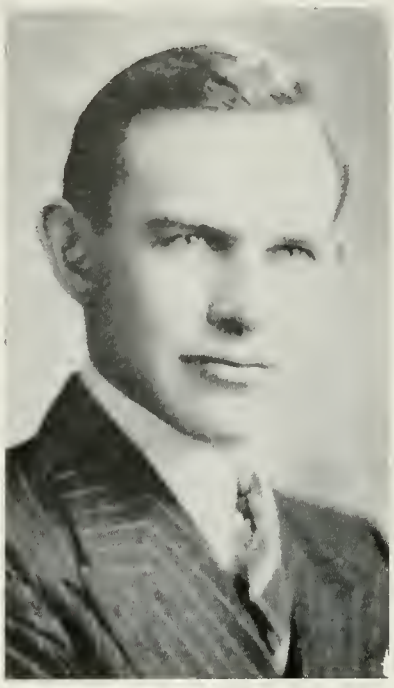
Original Air-Conditioner Cycle

By John L. Slonneger

The system described here is a cycle designed by the writer for the purpose of producing summer comfort conditions at a minimum operating cost. Comfort air-conditioning essentially requires a cooling device. The conventional systems now in use use refrigerants for this purpose. In the cycle presented here, air is used as the refrigerant. The average conventional cooling system requires approximately one horsepower per ton of refrigeration for its operation. The proposed cycle requires only one-twentieth horsepower per ton of refrigeration in the ideal case, (assuming iso-thermal compression and expansion) and even though we assume such a low operating efficiency as 25 per cent, the proposed cycle would require only one-fifth as much power to operate it as do the cycles now being used.

The proposed cycle is shown diagramatically in the figure. All of the outside air introduced to the room to be conditioned must first pass through a cooling and dehumidifying process. Outside air is drawn through the precooler. It is then compressed to a pressure of about two atmospheres and then it is sent to the intercooler. In this process some of the heat of compression is absorbed by the cooling water surrounding the cylinder, and some of it is absorbed by the water passing through the intercooler. Tap water is used for cooling the air in the intercooler and compression cylinder. This same cooling water is used afterwards in the precooler.

From the intercooler the air flows to an air-engine cylinder where it expands to atmospheric pressure. The system has a circulating duct that takes air from the room to be conditioned. The air-engine cylinder is located inside of the circulating duct so that the heat absorbed by the expanding air inside the cylinder is taken from the circulating air. When this air passes over the air-engine cyliner the expanding air within the cylinder absorbs some of the heat from the air passing over the cylinder, thereby cooling the air. This gives a desired effect by lowering the temperature of the circulating air passing through the duct. The air from the air-engine cylinder is discharged into the circulating duct. Once it is in the duct, it mixes with the circulating air. This mixed air is then discharged to the room that is to be cooled for comfort conditions. About ten per cent of the air entering the room is outside air that is discharged from the air-engine cylinder.



John L. Slonneger, Senior in M.E. and inventor of this unique device, wrote an article for The Technograph *in November, 1939 concerning his theory of light and heat which drew considerable discussion from our Physics department. He presented a paper analyzing the vibrations in oil well pump rods before the A.S.M.E. Conference in April, 1940, which took 2nd place. John is from Washington, Illinois and has many ideas on various subjects. He has accepted a permanent position in the Mechanical Design Dept. of General Electric, starting upon his graduation this June.*

As shown, the crank arrangement is such that the work done by the air-engine can be used to drive the compressor. The additional power needed is supplied by a small electric motor.

To remove heat from a room at the rate of 12,000 BTU per hour (equivalent to one ton of refrigeration), calculations show that this motor would have to develop about 0.05 horsepower. In making this calculation, the condition of the air and cooling water entering and leaving the system were assumed to have the values shown on the diagram. These values were selected to conform to conditions existing in Urbana-Champaign. If the air leaving the intercooler is maintained at a temperature of 73 degrees F or less, the air leaving the expansion cylinder will have been sufficiently dehumidified to give comfort conditions.

This system maintains comfort conditions with very simple controls, because the temperature and pressure of the air entering the expansion cylinder are the only things that control the moisture content of the outside air entering the cooled room. The maximum pressure in the system is fifteen pounds per square inch (gage). This value is lower than that used in most conventional systems. Theoretically this system is cheaper to operate than other systems now in use. Only through experiment to determine the actual operating efficiencies can the true operating cost of the system be determined.

HEAT REMOVING CHARACTERISTICS—Heat of outside air entering syst is removed by compressing the air and transferring heat of compression to cooling le On the other hand, heat is absorbed from air passing through recirculating duct by ea iso-thermal expansion of air within cylinder of air-engine.

DEHUMIDIFICATION STAGES—Outside air at conditions shown is drawn into re cooler where it is cooled to its saturation temperature, 73 deg. F. This saturated is compressed to ½ its original volume by compressor, being discharged to inter-cooler ere it is cooled to its original 73 deg. F. temperature. Since partial pressure of water por is a function of temperature only, and each component of a mixture may be cons red to occupy the entire volume of a mixture (Dalton's Law), therefore, water vapor be considered to occupy the entire volume at its partial prssure of 0.40 psi. abs. at 73 d F. Thus, this reduces to a plain steam table problem, i. e., since the specific volume the saturated vapor is reduced to ½ its original specific volume, it is obvious that the q lity of this steam will be 50 per cent, ½ of the vapor condensing. Now air entering th air engine from the intercooler has lost ½ its original moisture. By discharging the air om the air-engine at the same temperature and pressure as it had upon entering the m pressor, minus ½ its moisture, the relative humidity will be 50 per cent, the red temperature and humidity for comfort conditions.

'SCORCHED EARTH' . . . . *(from page 13)*

The principle of plane planting is simple. Movement through the air and wind created by the propellers blows seed outward as it slides from a hopper in the plane. Recently, a seed dispensing device, consisting of vanes on the bottom of the hopper and a small fan blade to throw the seeds outward, has proven a big success.

The accuracy and evenness of dispensing seeds was proven in a test of a 700 acre tract in the Squaw Creek country of Idaho. It was calculated that a piece of paper 12 by 18 inches should catch 21 seeds. Then greased cards were layed diagonally across the field, and a check showed that the average number of seeds falling on each card was 23. The plane used flew 300 feet above the field, at a speed of 80 M.P.H. To insure an even seeding, the field was cross seeded at right angles.

About 15,000 acres in Coos and Curry county, Oregon, which had been destroyed by a particularly heavy forest fire, was recently saved from waste by use of a plane planter. In this project, 55 ranchers pooled resources to buy seeds and hire a plane. A Stearman biplane, with a cruising speed of 120 M.P.H. was used in this operation, which turned out to be a great success. The plane used an average of 40 gallons of gas for each flying hour, and the cost was just $1.23 per acre, much cheaper than sowing by hand.

Two hoppers were used in the plane, each carrying 500 lbs. of seed. Fourteen inch vents with 3 inch openings were at the bottom of each hopper. These vents had baffle plates regulated by set screws, and controlled by the pilot from his cockpit.

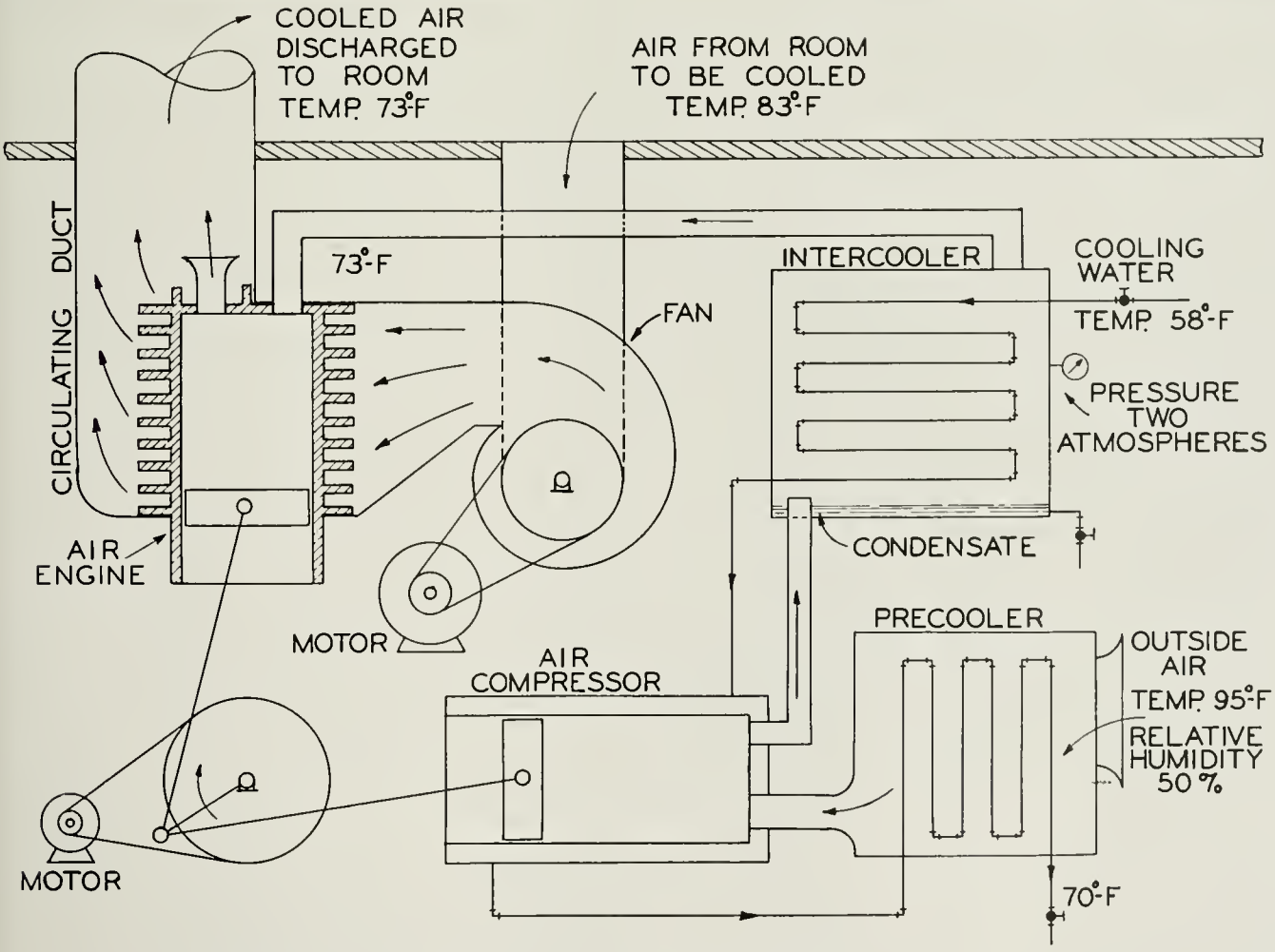
Tests have been conducted to find the best flying speed and flying time. These tests have shown that a plane flying at 500 feet above the ground at a speed of from 100 to 105 M.P.H. gives the most even seeding. August and September are the best months for planting.

Of course, seed planting by air requires the service of a good pilot, for the work consists of flying that is practically "hedgehopping." It is necessary for the pilot to be familiar with both the plane and the ground below. An inspector on the ground informs the pilot of changing air currents and other conditions by means of a flag, although a two way radio has been tried with more success.

Usually the pilot plants a 100 foot swath on each flight, sowing 50 feet on each side of the plane. This is the maximum range of seed distribution, but by using this distance, no overlapping is caused.

In California, where unprecedented numbers of fires have burned over land, leaving it bare of all vegetable matter, floods are a regular occurrence. These floods, which run down the bare hills and canyons, are effectively reduced by planting the hills with any vegetable matter, thus slowing up the flow of the water and preventing disastrous erosion. The Forest Service, realizing this, have used planes to replant many of these regions. It is interesting to note that instead of using grass, mustard seeds were used to replant such areas. These seeds send out a vigorous root system, and are low in price and easy to handle. The method used is the same as for other seeds.

It is hoped that other uses of the airplane, as beneficial as this one, will be discovered, and airplanes will not be used primarily as an instrument of death.



A SUMMER AIR-CONDITIONING SYSTEM

NAMES

. . . *in the news*

By William R. Schmitz
Freshman in Chemical Engineering

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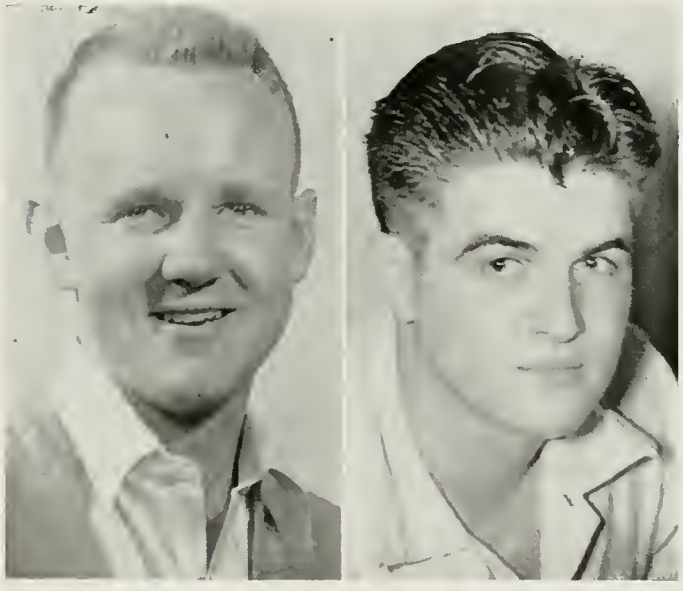
BILL STEWART

Bill is member of Pi Tau Sigma, Alpha Tau Sigma, A.S.M.E., Cadet Major in the Infantry, and captain of the university rifle team. During the past inter-unit rifle competition, Bill won individual first place. Bill has especially enjoyed rifle shooting as evidenced by the number of medals he has won. He has received so many that he must keep them in a box. The rifle team was pretty good this year, it won the Sixth Corps Area championship.

Right now, Bill's immediate plans are concerned with the army. However, he expects to receive a commission in the Ordnance Plant at Aberden, Maryland. Here at school Bill has been interested in heat treatment and design work. The M.E. laboratory has proved quite fascinating to him also. He has done very well in his subjects too, as shown by his respectable 4.4 scholastic average.

When Bill first started looking for a college to enroll at, he thought of entering California Tech. But he finally settled on Illinois because it was closer home, especially to his girl friend at Rockford, Ill. Bill is going to leave the ranks of a bachelor and marry his childhood sweetheart on the 24th of May. So we wish him a lot of success and happiness in his mariage. When quiered about his ambition, he replied, "I want to be a damn good machine designer."

Bill has had a chance to visit several other campuses, but he says that he will take good old Illinois anytime. Our military facilities are far above most other schools although they may have a little more beautiful scenery than we have here.



CHICK BILL

CHARLES IRISH

Charles Irish, better known to all his friends as "Chick", is a Metallurgical Engineer. Chick is a member of the national A.I.M.E., and is treasurer of the local Mineral Industries Society. When he graduates this spring, Charles is all set to go into the Navy with a "V special" commission. He doesn't know exactly what type of work he will be doing, but he thinks that it will be Diesel Engineering.

There are two types of Metallurgical Engineering and Chick favors Process Metallurgy. If he wasn't going into the Navy, he believes that he would like to enter the Production field and then use that as the basis of sales engineerin. However, he thinks that he might stick in the Navy for good if everything turns out all right. His ambition is to do some kind of executive work in engineering.

Chick spends a good deal of time working for the Collegiate Cap and Co. during both the school year and the summer months. He thinks that his greatest thrill will be when he steps up to receive his diploma after having worked so hard to get it. But he ranks his commission in the Navy a close second.

JOE LAVERNE

Chick hails from Decatur, Ill., and lists sports of all kinds as his hobby. He says that he first got the urge to come to college while he was visiting one of the northern colleges and a group of sorority girls serenaded him one night. Chick likes to take in all social events, but insists that he must have variety among the girls.

JOE THOMPSON

Activity man among the mechanical engineers is Joe Thompson. Joe's pet peeve is engineers who say they don't have time to work in activities. Practicing what he preaches, Joe has been quite an active man. He especially likes to meet people and make friends with them. It must be this quality which makes him such a good-natured engineer.

Joe is a member of A.S.M.E., Tau Nu Tau, Alpha Phi Omega, and Pershing Rifles. He was for a while a member of the Advanced R.O.T.C., but because of a physical handicap he was forced to drop out of it. Also a member of the Independent Council, Executive council of MIWA, Y.M.C.A., Senior Ball committee, Slide Rule Shuffle committee, and is now president of the University Model Airplane Club.

Quite an enthusiast about model airplanes, Joe has won several trophys, among them a second place in the Mid-Western States Championship, and an outstanding achievement award in model aeronautical engineering. After graduating, Joe expects to enter the production engineering field, but he hasn't definitely decided yet.

Joe also likes to tinker around with old cars, and has built a sail boat which he makes good use of in the summer. Tennis and weight lifting prove fascinating to him as well as does concert music. Joe plays a piano accordian and is an ardent Jitter-bug. He is not slow in getting around with the co-eds either, but complains that they don't dance as well as they could. He advocates that engineers should have a lot of social life.

(Please See Page 24)

TECHNOCRACKED . . .

By Edward C. Tudor

Senior in Electrical Engineering

Ed. Note: This is positively the last (you hope) that Ed's infamous 'Rougher-than-a-Cob' style of columnism will appear under TECHNOCRACKED.

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We see where the University has given the Old Gym over to the Navy. The Navy plans to install 800 men therein for the purpose of starting a signal school.

Just our luck. After the draft was getting the ratio down to something smaller than an astronomical expression the government comes along and blasts h--l out of it.

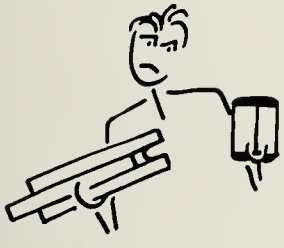
But the co-eds won't have such a field day as might appear. The sailors have to stay on the reservation at all times except Saturday night and Sunday afternoon. This leads us to believe that the Committee on Student Affairs will soon be raving about North Campus as much as they do South Campus.

According to the latest communique the boys in blue will "receive training in visual signals." We get it. The old Illini standbys like the handkerchief flutter, the sly wink, and the lifted eyebrow.

Instead of hanging around the phone, the local gals will now spend their time on the roof with a pair of binoculars receiving blinker signals from the Old Gym.

* * *

Since this is the last issue this year, and since we are going to be graduated —allegedly, this will be our last chance to give prospective freshman engineers a little sage (?) advice. Below are listed a few of the courses in the engineering curriculum with a little inside dope.



Computing 'Flunk' possibilities

C. E. 15—This is a survey of a survey course in surveying. Best time to take it is during the spring when the co-eds spend their off hours on the library steps. You might as well put the transit to good use since the rodman is always in the wrong place anyway, and besides he's too far away to successfully cuss out.

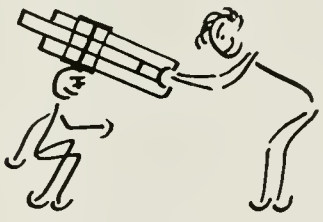
E. E. 95 and 96—After the first eight weeks this course resolves itself into a contest between the senior E. E.s and Professor Paine to see if any of the boys can find anything to talk about that Prof. Paine isn't hep to.

Eng. 39—Theoretically this course is on industrial relations. The final benefit results in the student's being able to tell the difference between a sit-down strike and the Illini football squad in action.

INTRODUCING

Engine-School Eddie, '45

The frosh Engineer caricatured on these and following pages is from the skillful pen of John Replinger '15, of the Civil Engineering School. John lives at the new Men's Residence Hall and is from Lombard, Illinois.



Brawling

G. E. D. 12 — This is a one-hour course. (According to the catalogue.) It is also a good example of the reason capital and labor fight over the 40-hour week.

M.E. 10 and 13—Thermodynamics—also known by other names, some definitely euphonic. Causes one to marvel at the complex processes set into motion by striking a match.

Any Physics Course—These courses usually give the student the opportunity to think over this proposition of becoming an engineer. Many students think it over twice and then go into bee-keeping. No comment on the Physics Dept. This rag is censored.

Any T. and A. M. Course—Known as Gripe 1A. No comment needed.

* * *

Besides the courses, there is always the curriculum. Every senior will argue with all the enthusiasm of a Dodger infield chasing an umpire that his department is the toughest one in the whole university. We feel qualified to make a few remarks on each one after five years as an undergraduate. (Ed. Note: The five year plan was devised by those with communistic tendencies and is not recommended except in isolated cases.)

How about that, huh?

Ag. Eng.—The lads in this department are seen occasionally north of Green street. Most of their time is spent learning how to drive a tractor straight enough to plow a furrow. After this training they are a cinch for the Tank Corps. We would say more, but they read *The Agriculturist* and the effort would be wasted.

Ceramic Eng.—These guys are the most convincing gripers on the campus. The most effort we have ever seen expended is the baking of ash trays for Engineering Open House. In case you have never seen a Ceramic engineer running around loose don't feel that you don't get around; they hang out in the hinterlands of the engineering campus, the region being more commonly known as the Ceramic Building. We've never seen the place ourselves, but we understand that it is somewhere back of the Transportation Building.

Chem. Eng. — These guys are supposed to be in LAS, but their appearance belies their college. The prime advantage of being a Ch. E. lies in the fact that they never need excursions to Bidwell's to fortify their morale since they can brew their own with the University's equipment.

C. E.—These are the lads that keep 608, Bunny's, and Twenty Taylor on a paying basis. (Ed Note: Why not? They have too much spare time anyway.) We knew a C. E. once who spent three semesters trying to find something to do in the way of studying

(See Page 19, Sucker)

EDITORIAL

This is the last issue of TECHNOGRAPH for this semester. There will be no summer school edition. Next fall the magazine will be in new hands, hands as yet unselected by the Illini Publishing Company Board of Directors.

However, regardless of who is selected to head the Business Managership and the Editorship, TECHNOGRAPH offers an excellent chance for extra curricular work. Membership on the staff goes a long way in impressing many prospective job interviewers near graduation time.

Editorial work helps the engineer to develop the ability to write reports now a very vital part of an engineers training, and to put down in black and white any or all ideas that might otherwise never find expression. There is a certain undescribable sense of satisfaction in seeing the words from ones own pen in a printed magazine that can be found in many large libraries all over the United States and in engineering universities.

Work on the business staff teaches the value of bookkeeping, economics, and something of the difficulties of business administration.

Any staff position develops dependability and initiative, qualities which our nation at war is in dire need of at this crucial moment.

Matrix keys for conscientious work on the staff are awarded members at the end of each year.

Technograph also offers an excellent outlet for undergraduate idea expression. Many patentable ideas have first made their debut in college engineering magazines. (See John Slonnegers original plans for a summer comfort air-conditioning unit in this issue.) Many of the authors of new ideas have received high salaried positions upon graduation on the strength of their printed articles in college in college engineering magazines.

Remember, the TECHNOGRAPH is no pieayune pamphlet with purely local circulation, but is read on engineering campuses all over the country and out in industry.

National advertisers realize the value of featuring engineering products and services for the future engineers from one of this country's most famous engineering schools. Thus they have favored TECHNOGRAPH with the second largest amount of advertising given college publications by national advertisers in this country.

TECHNOGRAPH is looking for new talent and ideas. Engineers, this is your paper! Subscribe for it, read it, show it to your friends and parents, and try out for a staff position. If you are interested make it known to Editor Don Stevens (telephone 7-2820), for there is undoubtedly some position which you can successfully fill if you so will it, thus aiding the Magazine, the University, and yourself!

ROBERT E. McCLEARY, '43
Assistant Editor

DON

"TECH" MANAGERS *Bid U. of I.* FAREWELL

☆ ☆ ☆

DICK

Above are the pictures of the Editor and the Business Manager of Technograph for the past year. Donald Stevens is a Ceramic Engineer, Richard Landon is an Electrical Engineer. Don is not so tall, is an independent and loves military, holding the rank of Lieutenant Colonel in the Coast Artillery Corps of the R.O.T.C. Dick is over six-foot all, a member of Phi Gamma Delta, and is not in the Advanced Military Program.

However, it may be said that they both have in common the title of B.M.O.C., and have both held many important positions and served on numerous committees throughout their school years here. They both graduate this June.

The list of their accomplishments is impressive.

Don is a member of Tau Beta Pi, Phi Eta Sigma, Alpha Phi Omega, Sigma Tau, American Ceramic Society, Coast Artillery Club, Keramos, Pershing Rifles, Scabbard and Blade, Thunderbird Battery, Mens Glee Club, Engineering Council, and has the Scholarship Key.

Dick is a member of Phi Kappa Phi, Tau Beta Pi, Eta Kappa Nu, Sigma Tau, A.I.E.E. and Engineering Council.

These two boys were fated to become the hosts of the famous Engineering College Magazines Association Conference which was held here last November and which was attended by Engineering Editors from all over the country. This task they performed with precision and finesse. The Conference proved an unmistakable success with 76 delegates attending, the largest attendance in years.

Technograph has fared well under their able and brilliant administration. More pages were printed per issue this last year than under any other regime in the past five years. We believe the magazine has been conducted on a very creditable plane this last year and to its leaders goes the largest share of credit.

So long, Don and Dick. . . We wish you the success in life we know you will be certain to attain.

•

This May issue was compiled and edited by Robert E. McCleary '43 and Sheldon J. Leavitt '13½.

TECHNOCRACKED . . .

(from page 17)

and finally wound up in a sanitarium, a victim of dypsomania brought about by frustration.

E. E.—The E. E.s, also known as the playboys of North Campus, occasionally are seen manipulating a slip stick. Most of their time is spent arguing with Commerce studets in the local coke joints; the inevitable result of these arguments is the Engineer coming out second best but with a feeling of superiority that springs from his untouchable ego.

Eng Phys. — Occasionaly someone registers at the State U. who is too impractical to be an engineer and too practical to be a physicist. The result is one more in the curriculum of Engineering Physics to further disturb the members of two departments at once.

General Eng.—These are the lads who are unable to make up their mind, and after graduating as a General Engineer come back to the State U. to major in some department so they will be able to hold down a job.

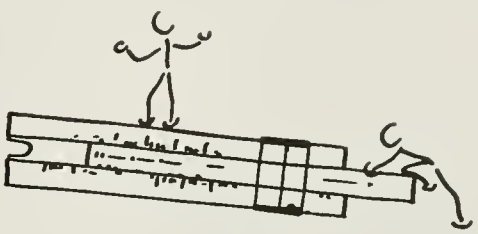
M. E.—These jokers know every hot spot within a radius of fifty miles. Their information is obtained directly from their instructors who apparently haven't heard that the term "Joe College" is only applicable to LAS students.

Met. Eng.—Once in a great while a Met. Eng. wanders away from the Met. Lab. and gets lost along Sorority Row. This is the only time they are seen in public. Just exactly what the life and habits of a Met. Eng. are is one of the campus mysteries.

Mining Eng.—Contrary to popular opinion a Mining Engineer exhibits none of the characteristics of a mole. The pasty complexion is not a result of hours spent underground but is that not-too-uncommon affliction known as night club tan.

* * *

This winds up our stay with the Tech., and at this point we take a brisk walk around the block to our oxygen tent.



Climbing toward graduation.

Old Gym, North of Talbot Lab.

★ ★ ★

OLD GYM

Converted to

"NAVAL TRAINING SHIP"

By William G. Murphy
Junior in Civil Engineering

With most of the men on the campus wondering about what the addition of about 800 "bluejackets" will do to the date ratio, the engineers are beginning to wonder how they might be affected by the navy's technical school on campus. The answer is that you won't notice their presence unless you number among those who had a P. E. class changed to Huff Gym, and even then you will only he a little later than usual for your class in Tarnsoprtation the next hour.

Some of the civil engineering students will do their part for national defense by giving up their design rooms and class rooms on the fourth floor of Engineering Hall. The navy will use these rooms for class room instruction.

The Old Gym and the property immediately around will be the same as any ship in the fleet as far as the trainees are concerned. The ship, however, will be in port every weekend so if these sailors live up to their reputation —look out!

The time during the week will be spent studying. Their course is divided into six major parts, namely: visual signaling, blinkers, semaphore, flags and flag hoists, navy procedure, English and spelling, and general instruction. An additional study section will be held at night on the "Bluejacket Manual" which contains information of all types of concern to navy men.

The course of instruction will be sixteen weeks long, and at the end of that period the men will be sent to sea as Signalmen, third class, a petty officer's rating. Those who don't qualify during this period will be assigned to ships as signal strikers, and at the end of an apprentice period in this capacity they will receive their rating as a Signalman, third class.

The 800 men will come to the school from all over the country, but the largest numbers will be from the training centers at San Diego, Great Lakes, Newport, and Newark. Some will be veteran seamen, but a large number will be new men from the navy reception centers. All have had a high school education and many have college degrees. Some of the famous athletes of the recent years will be included in the group. An additional 100 men will be stationed here by the navy to act as instructors and to carry out the administrative details of the "ship." The "ship's company" will include several of the veterans of the last war who returned to the service to fight for their country in a different capacity.

Lt. Charles H. Bowman, the commandant of the school, came up the hard way from the "rank and file." He enlisted at the age of sixteen, and during the later part of the six year enlistment, he studied law. Following his discharge he graduated in law from Cumberland University. He attained a reserve commission in the navy and in the summer of 1940 he was calle dto active duty.

The blinker course will be the only thing to resemble any course given the Signal Corps in the R.O.T.C. brigade. It will include the operation of the blinker, the directive flash, wig-wags, signal lamps, and the Very pistol. In their course of general information, the trainees will receive a brush up on arithmetic and algebra in order to enable them to compute deviation and variations.

The Technograph welcomes the "gobs" to their inland ship and wish them all the success possible in the course. And as a brother in the defense of our country I say "Bon Voyage!"

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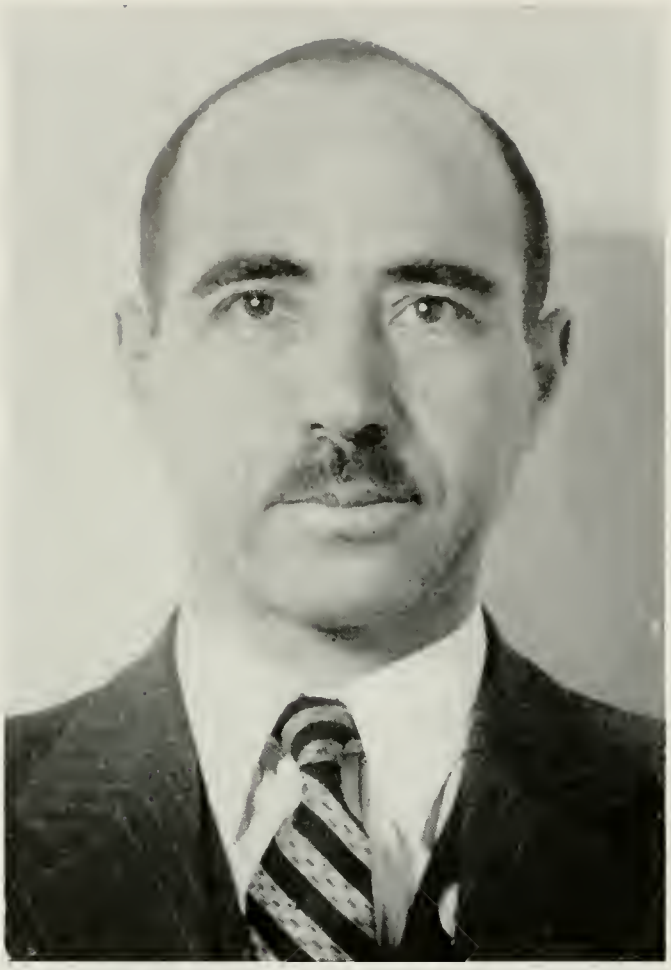
'Alum' Invents Iron-Glass Seal



DR. NAVIAS

☆

Tight seals between iron and glass, eliminating the need of nickel and cobalt, critical war metals, for wires leading into certain types of vacuum tubes, are now being made with a new development of General Electric scientists. Dr. Albert W. Hull and *Dr. Louis Navias,* of the G-E Research Laboratory, have just been granted a patent for their invention.

From early days of the electric lamp, a problem of construction has been to make a tight seal between metal and glass. It is also involved in making radio tubes. Even with tubes in which the glass shell is replaced by one of metal, the lead-in wires pass through glass insulating bushings.

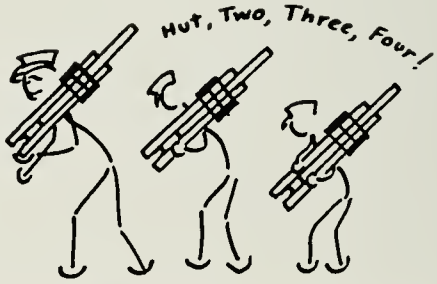
The difficulty is that most kinds of glass expand with heat at a different rate from that of the metal. Glass and metal may be tight at one temperature, but when they are heated the glass will either crack or pull away from the metal, because the change in their dimensions is not the same.

Platinum was used in the first electric lamps, since it has nearly the same rate of expansion as the glass then employed. Various substitutes for platinum were devised, which were satisfactory for lamp seals, though they were not adapted to the large seals used for powerful vacuum tubes, for example. However, Dr. Hull and others developed special nickel-iron-cobalt alloys for this last application.

Since nickel and cobalt are used in many ways for war equipment, and their supply is extremely limited, the new invention of Dr. Hull and Dr. Navias is an important one, since for certain applications, it permits tight seals to glass without their use. They have devised a series of glass compositions which can be used with iron and certain iron alloys. One consists of 45 per cent silicon dioxide, 14 per cent potassium oxide, six per cent sodium oxide, 30 per cent lead oxide and five per cent calcium fluoride. The rate of expansion of these glasses is very close to that of iron.

In seals using these glasses a further and separately patented invention of Dr. Navias also proves useful. When a glass containing lead is sealed in contact with iron, some of the lead atoms migrate from the glass into the metal. This weakens the joint, and may let air leak into the tube. Dr. Navias proposed placing a thin layer of lead-free glass directly over the metal, then sealing the lead-containing glass to that. The thin glass layer prevents the lead from reaching the iron, yet it is not thick enough to crack and let air in.

Dr. Navias was graduated from the College of City of New York in 1918 with the degree of B.Sc. in chemistry. In 1921 he received his M. Sc. in ceramic chemistry at this University and two years later his Ph. D.



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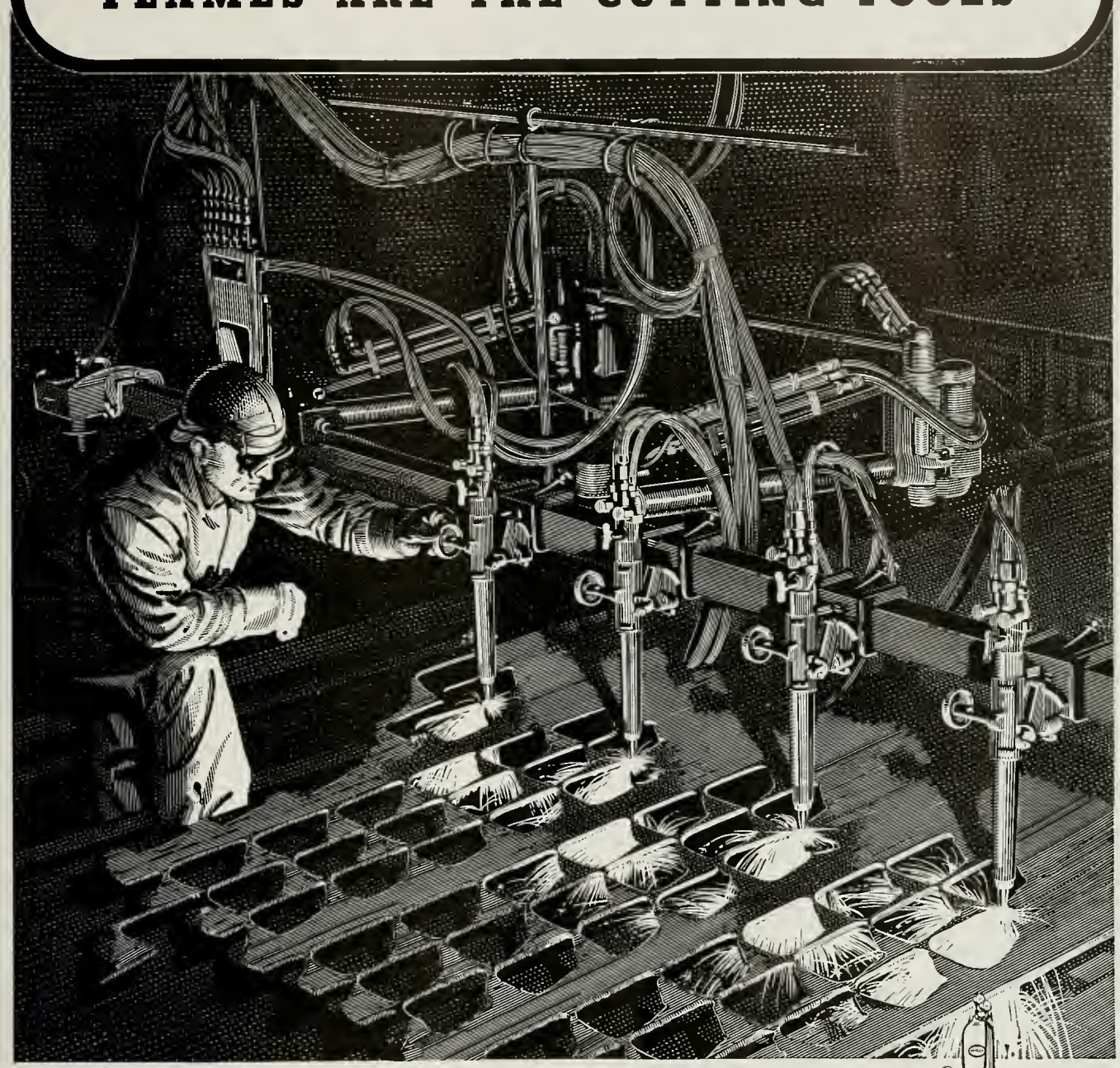

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Other defense jobs being done by this versatile metal working tool include hardening steel to any degree and depth; welding two or more metal parts into a strong, homogeneous unit; machining metals with unrivaled speed, and cleaning and dehydrating metal surfaces for long lasting paint jobs. To insure greatest speed, efficiency and economy in applying the Airco Oxy-acetylene Flame to defense production, Air Reduction offers industry the cooperation of a complete engineering staff.

To better acquaint you with the many things that this modern production tool does better we have published "Airco in the News", a pictorial review in book form. Write for a copy.

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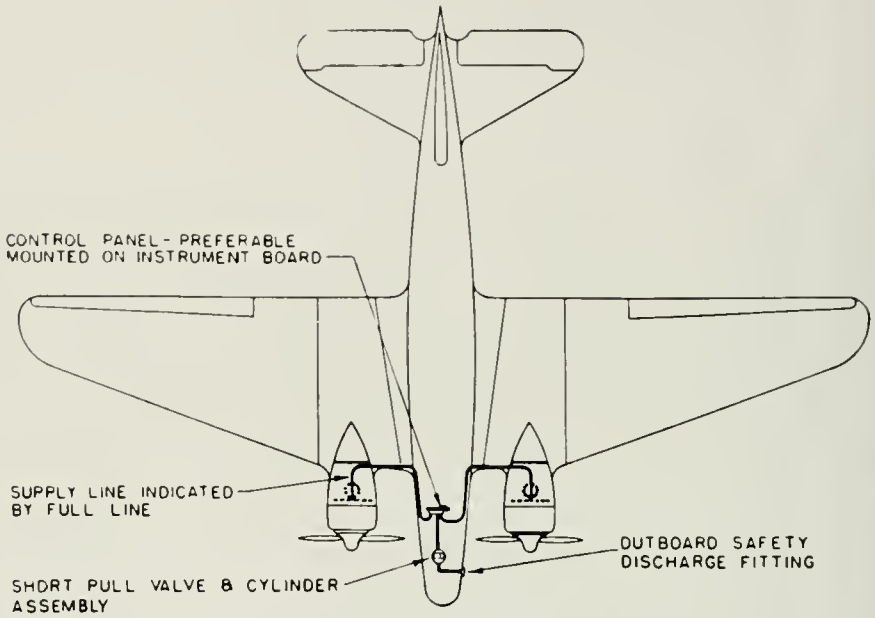
By Edwin Thomasson
Freshman in Mining Engineering



Schematic diagram of extinguisher layout.

One of the greatest dangers to aviation has been, and still is, fire. The engines, being extremely light and extremely powerful, often operate at very high temperatures, and as a result, fire sometimes results, causing crashes, loss of plane, and loss of life.

However, it is now possible to equip airplane engines with a sure and almost foolproof fire extinguishing system. This device forces a flood of Carbon Dioxide gas throughout the entire engine, which quickly extinguishes any flames that may be present. It is controlled by the pilot from the cockpit or cabin of the plane, from where it may be turned on at will.

The system, in itself, is quite simple. It consists of a cylinder which contains from 5 to 15 pounds of liquid carbon dioxide, a quick release valve, a perforated ring which fits around the motor, a nozle which fits into the carburetor scoop, and a control panel. When the control lever is pulled, it opens the valve, allowing the CO_2, which is held under pressure, to expand greatly, and thus flow into the perforated ring and nozzle, and from there into the engine. Because it is under such pressure, the gas flows from the ring with a great deal of force, thus flooding the engine with CO_2. Since the CO_2 rushes in with such force and in such great quantities, it immediately displaces all the oxygen from the area surrounding the engine, and the flame, having no oxygen, quickly goes out.

The extinguisher is easily installed in any type of plane. The cylinder containing the CO_2 can be mounted any place in the fuselage. However, it should be placed so that the control cable and the gas supply line, leading from the cylinder to the ring, are as short and straight as possible. The second step in installatoin is mounting the ring. It is fastened securely to the engine mounting ring, taking care that no holes in the ring are covered by the mount fastenings. The nozzle is then connected to the carburetor scoop. The nozzle is merely an added safety factor, since most trouble begins in the carburetor, and the flames will remain there longer than any other place.

Only one factor need be considered in installing the system. There are two distinct types of cylinders, one made to be mounted horizontally and the other to be mounted vertically. The mounting place must be selected and the correct type of cylinder installed to give satisfactory results. Then too, the type and size of the engine should be a governing factor. The cylinders are made to hold varying amounts of CO_2, and should be chosen by the size of the engine.

It is entirely possible to have one system on a multi-engine plane. The only additional equipment needed is a distributing valve, allowing the gas to flow to only one engine. In operating this type of system, it is necessary for the pilot to first turn the operating handle to the correct engine before pulling the release cord. Thus, the operating handle is set in a neutral position, and the system will not work until the handle is pointed at the "right engine," or "left engine."

With airplanes so necessary and so vital to America these days, it is hoped that this simple but ingenious fire extinguishing system will do its part in preventing crack ups and in saving planes.

NAMES IN THE NEWS . . . *(from page 16)*

LA VERNE BIRKS

La Verne Birks, better known to his friends as "Shorty," is an engineer physicist. At the present time he is busy helping the E.E.'s out. He is in charge of the program for the coming E.E. show. He believes that if you go in for anything, you should go in for all there is in it. One thing that La Verne especially hates is to have to wait around for someone when something else should be done.

La Verne has done well while in school here. Among the courses that he has especially liked are astronomy, X-rays, and building space models of molecules. Having a good 4.75 scholastic average, La Verne is a member of Sigma Phi Delta, Tau Beta Pi, Sigma Tau, Pi Mu Epsilon, Phi Eta Sigma, and Physics Club.

Claiming Rockford, Ill., as his home town, LaVerne came to Illinois because thought it was a lot easier to go to school than to work. He got his first taste of engineering while working in a metallurgical laboratory, and from then on he was certain that he wanted to be an engineer. When he graduates this spring, La Verne is all set to join the Rohm Haas Co. He expects to work in the research laboratory where he will help make clear windows out of acryclic resinsis for our bomber planes.

La Verne particularly likes to play golf, tennis, and to swim and to bowl. He also likes to dance, but since he is pinned to a girl back home, he has not been too active in social circles. He says that he really likes to entertain his girl down here at the University, and he hopes someday to have a nice home in sunny California.

COLOR FOR RUBIES . . .
BACKBONE FOR STEEL!

Chromium, the element that imparts precious color to rubies, imparts something more precious to steel. It gives steel incredible hardness and resistance to heat and corrosion. It makes steel strong, yet ductile and shock-resistant.

Chromium is the key that has opened — and is still opening — great new fields of application for steel. Without chromium, the whole wonderful series of *stainless steels* would not have been possible. From tarnish-free tableware to corrosion-resistant chemical equipment . . . from strong, lightweight truck bodies to streamlined trains and airplanes . . . from heat-defiant boiler tubes to high-temperature steam turbines . . . chromium has made possible a *steel* with properties of the *noble metals.*

But the stainless steels are only one great contribution of chromium. This element has also helped to provide hard, shock-resistant armor plate and armor-piercing projectiles; long-wearing engine valves; strong, tough gears, tools, ball bearings, car trucks, shafts, springs, and dies; and hundreds of other improved articles.

We do *not* make steel of any kind. But for over 35 years, we have made ferro-alloys and alloying metals used in steel-making. Among these are chromium, silicon, manganese, vanadium, tungsten, zirconium, columbium, and calcium.

It was our research and development that made the low-carbon grades of ferro-chromium available commercially. Without these, production of a majority of the stainless steels would have been impracticable. Inquiries about stainless and other alloy steels — their manufacture, fabrication, and use — are cordially invited.

The progress made by Electro Metallurgical Company in the manufacture and use of ferro-alloys and in the development of alloy steels has been greatly facilitated by metallurgical research in the laboratories of Electro Metallurgical Company and Union Carbide Company; by the advances in electric furnace electrodes and techniques of National Carbon Company, Inc.; and by the broad experience in the production, fabrication, and treatment of metals of Haynes Stellite Company and The Linde Air Products Company. All of these companies are Units of Union Carbide and Carbon Corporation.

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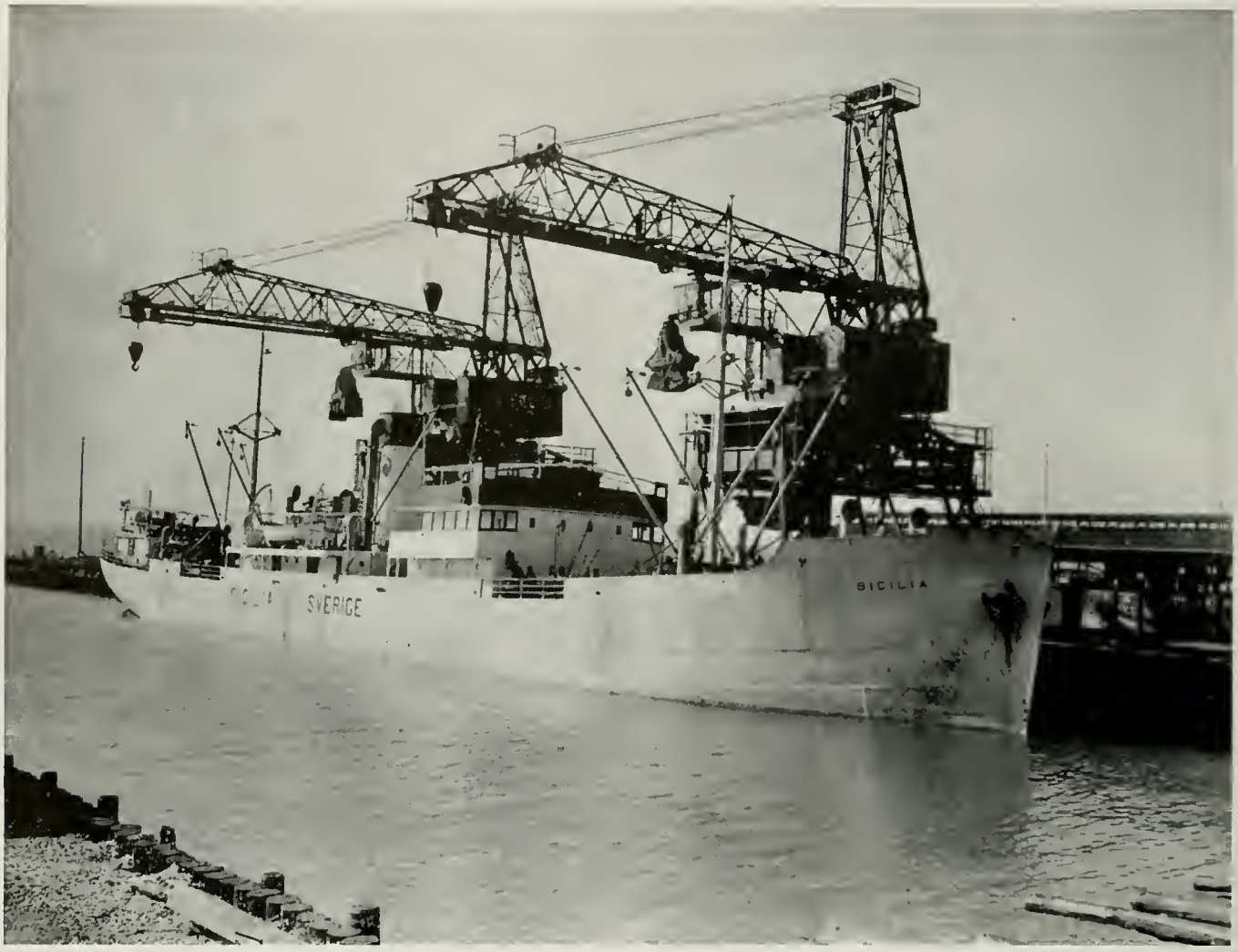


Ore boats like this one at Newport News keep Great Lakes Steel mills supplied. (courtesy Westinghouse)

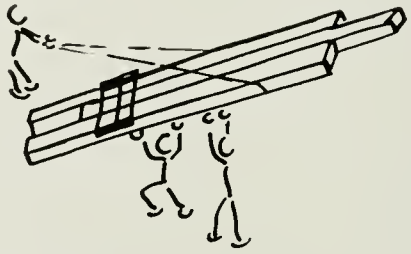
War Boosts Steel Production

All daily and monthly world's records for blast furnace production were broken April 1, 1942, by Great Lakes Steel Corporation's Zug Island furnace, with a straight ore burden production for the month of 43,478 tons and the final day production of 1608 tons, George R. Fink, president, announced today. The previous widely acclaimed world record of 41,782 tons for one month was set a few weeks ago in Pittsburgh.

The new figures are approximately 40 per cent ahead of the average for a large furnace before Pearl Harbor. This record was established with a consumption of less than 1,700 pounds of coke per ton of iron produced — a decrease of five per cent in the consumption of coke, a vital war material. Furnace crews throughout the country in the race against time have been exerting every effort to win this distinction and, with the cooperation of the War Department, the competitive spirit has resulted in hundreds of thousands of extra tonnage.

This is the second record set by the Great Lakes Steel furnace, the largest in operation anywhere. It was built and blown in December 9, 1941. Ordinarily, it would take eighteen months to build. This one was completed in six months.

"Every tap for a Jap" was the slogan of the men as they neared the record and ran their last day's score to an unheard of tonnage. Almost all have sons, brothers, and relatives in the army, navy, and air force, and they set out to back them up with a record production of vitally needed steel. To "tap" a furnace is to release the molten pig iron, which is conveyed down the cast house and branches off to drop into 110-ton hot metal ladle cars in which it is transferred to the mill to be converted into steel. Great Lakes Steel, a unit of National Steel Corporation, is almost 100 per cent on war orders, its steel, much of it low alloy which cannot be produced elsewhere, going into materials for the War and Navy Departments.



Driving toward a 5-point (?)

The little glass fireman that draws no pay...

TAKE a good look at this picture. For without a ladder you seldom get a close-up of a sprinkler head.

This one is said to be the last word—so reliable that industries which equip their buildings with this little "fireman" obtain low insurance rates. Users say it pays for itself.

When the heat of a fire reaches a certain temperature, the little "Quartzoid" bulb you see in the sprinkler head is shattered by expanding liquid inside it. A valve is thus released, and water is directed onto the fire.

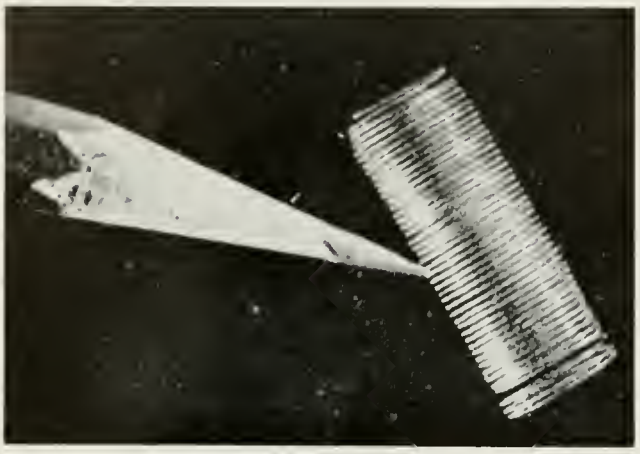
For the engineer, there's more to that little bulb than meets the eye. For one thing, it replaces alloys formerly used. For another, it shows how glass can now be made into accurate mechanical parts. The bulb must shatter at a specific temperature. And it must shatter completely, with no splinters to hinder valve action. Too, it must fit its hardware exactly. So it's up to Corning to supply glass free from weakening flaws and to hold wall thickness and O.D. to the small tolerances that can make or break the efficiency of a sprinkler head.

Fussy? Sure. But fussy and tough jobs are stock in trade at Corning. Did you know for instance that Corning makes a light globe that also protects industry because, unlike the "Quartzoid" bulb, it will *not* shatter? That Corning has developed industrial glasses to withstand heat that turns metals to liquid? Or that glass springs from Corning will outlast metals in fatigue tests?

These few examples give you an inkling of the growing usefulness of glass in these days of material shortages. No wonder engineers with urgent problems say "Ask Corning." Corning Glass Works, Corning, N.Y.

CORNING
means
Research in Glass

Quartz Spring



Quartz spring and pencil.

Because it excels the best spring steel in several respects, glass-like clear fused quartz is being used as springs to indicate minute differences in weight in the General Electric research laboratory at Schenectady, N.Y.

Springs made of hair-like filaments of quartz can be stretched to ten times or more their original length and will return exactly; steel springs would undergo a permament stretching. Quartz has an extremely high melting point, and quartz coils can be used at high temperatures; steel springs lose their temper at a relatively low temperature. Quartz spirals are not affected by any degree of humidity; steel is subject to corrosion. Quartz is practically invulnerable to the multitude of chemicals encountered in a laboratory; many affect steel. And finally, quartz coils weigh far less than and have resulting advantages over corresponding steel springs.

In the laboratory investigations the quartz springs are usually suspended within a glass tube maintained at the desired temperature by immersion in an oil bath. A small glass "Boat" suspended from the coil holds the sample under investigation. As the sample varies in weight, so does the length of the quartz spring; since the length of the spring is proportional to the weight, readings of length give accurate weight values. Measurements are made within an accuracy of a milligram, or 1/28,350 ounce.

The quartz springs are used in measuring weight changes of various materials under different conditions of heat and humidity. In measuring the moisture absorption of cotton, the sample is suspended from the spring in a vacuum and the stretch of the coil noted. As water vapor is intro-

(Please See Page 30)

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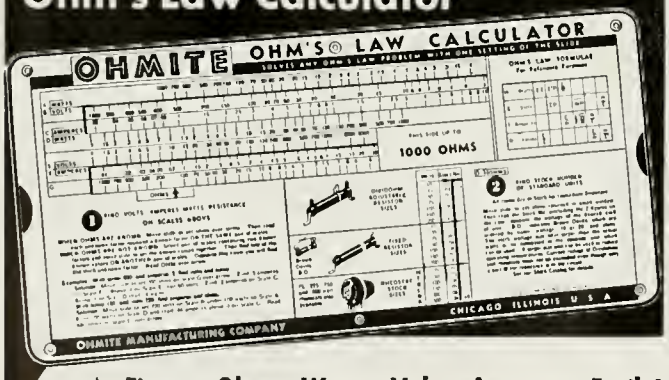

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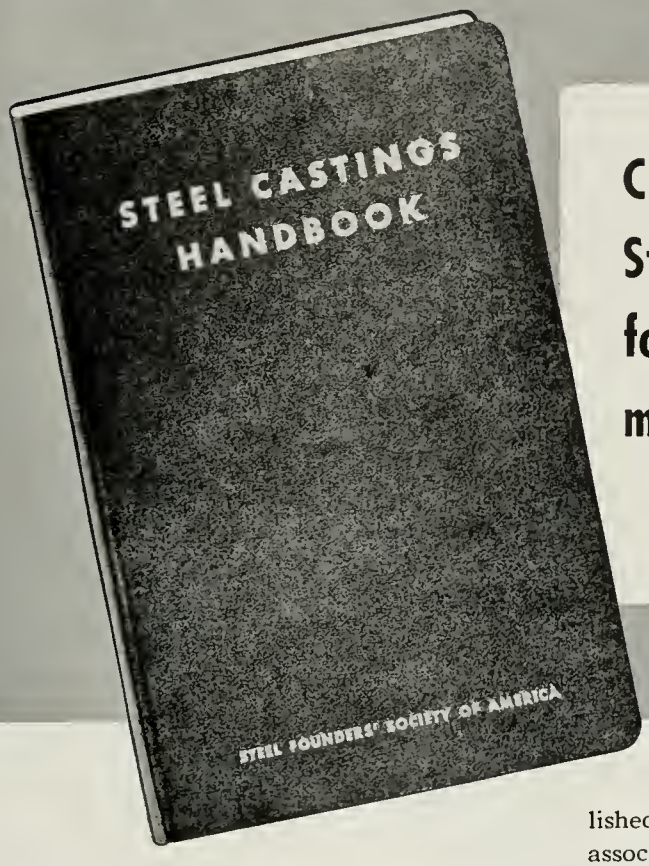

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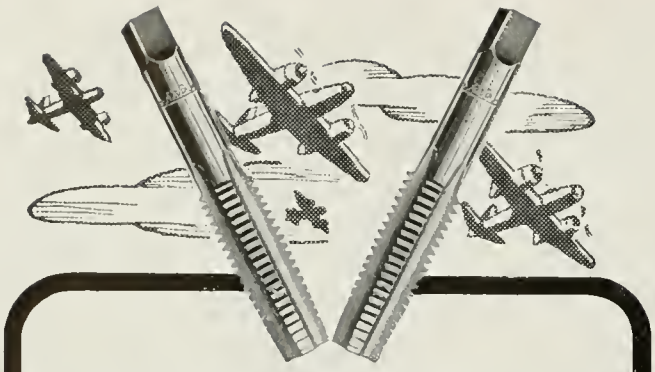

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QUARTZ SPRING . . . . . *(from page 28)*

duced at different pressures, the amount of absorption can be determined by the increase in the length of the spring. Another application has been in measuring the rates of decomposition, in high vacuums, of such materials as organic resins.

The quartz coils used in making the measurements are produced in the G-E research laboratory out of rods of the fused material as produced in General Electrics' Thomson Research Laboratory at Lynn, Mass. Some of the coils measure $\frac{3}{8}$ inch in diameter and $1\frac{1}{2}$ inches in length and have 50 turns to the inch; other are of $\frac{5}{8}$- or $\frac{3}{4}$-inch diameter and have as many as 80 turns to the inch.

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America's unlimited source of Magnesium

EVEN TODAY with astronomical figures a commonplace, nine billion is a number sufficiently vast to jolt the attention of anyone except, perhaps, an astrophysicist.

Imagine trying to count up to nine billion! Yet that is the total you would have to reach if you counted every pound of magnesium that could be produced from a cubic mile of sea water.

When you recall that magnesium, lightest of all structural metals, is vital to the construction of airplanes and other war-time equipment, you begin to realize the importance of those nine billion pounds.

And when you read also that the production of airplanes to be reached by the end of 1943 is set at 185,000, it is reassuring that the ocean can be looked to for this precious weight-saving metal.

Magnesium is now being extracted from sea water. The metal has been rolling out since January, 1941—a chemical and engineering feat accomplished for the first time in history.

Fortunately, for our national defense program, Dow had been producing magnesium from brine since 1915. This had given American industry 25 years of experience in the characteristics and fabricating technique of magnesium.

It was this quarter century of magnesium production by its own American-developed processes that enabled Dow to solve the chemical engineering problem of tapping the inexhaustible waters of the sea as a basic magnesium source.

Within nine months after construction started on the coastal plant, the ocean was giving up its treasure. The waters of the sea were pouring in and the metal was rolling out in ever-mounting volume.

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G-E Campus News

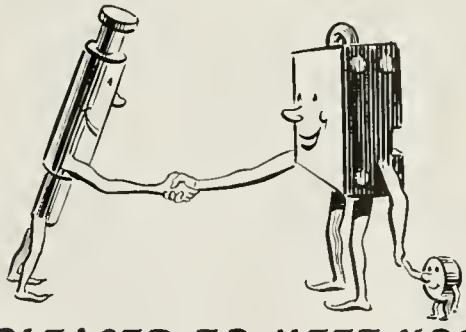
AU-TUBE-IOGRAPHY

GENERAL ELECTRIC'S Radio and Television Department, in its new Radio News Program with Frazier Hunt, is telling the story of electronics to a nation at war—a war in which electronics itself is one of our most powerful tools.

For electronics—the youthful science that embraces all the varied applications of electron tubes—is going into war not only on the front, but behind the front, where it is today revolutionizing many industrial practices.

Unique about this thrice-weekly broadcast (Tuesday, Thursday, and Saturday) is the fact that G.E. is using an electronic device, radio, to carry the story of electronics to America.

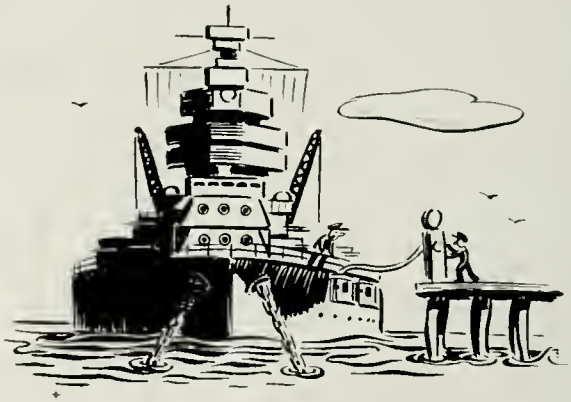
In addition to 51 stations of the Columbia Broadcasting System, G.E. is using the first network of FM stations ever to carry a regular series of broadcasts.



"PLEASED TO MEET YOU"

IT USED to take General Electric 18 months to build one of the great 275-ton machines that cut low-speed gears for cargo-ship propulsion sets. Today that time has been halved by farming out the construction of parts to dozens of subcontractors.

Major parts of the machines come together for assembly from 12 separate subcontractors in five states; miscellaneous smaller parts come from 38 firms in seven states. Jobs of casting, annealing, and machining involve, besides foundries and steel companies, a Navy yard, shipbuilding yards, a locomotive company, and a maker of steel safes. Co-ordinating and checking all these widespread activities is a major achievement in itself, since the finished machine has to be precise enough to cut gears with an accuracy of 3/10,000 inch.



"FILL HER UP!"

BECAUSE the ocean isn't equipped with filling stations every few miles, naval vessels must carry enough fuel for long voyages. And because finding storage room aboard for this fuel is a serious design problem, anything which cuts down fuel consumption is a great advantage.

Most naval ships today are driven by steam turbines connected to the propeller shafts, through reduction gears. And turbine engineers, working with the Navy, have pioneered in the use of higher steam pressures and temperatures—producing turbines of such improved efficiency that in modern ships the fuel consumption per horsepower is from 25 to 40 per cent lower than in vessels of the same type used during the first World War. Thus it has been possible to design ships with greater cruising radius for the same amount of fuel oil, or with more armor and guns for the same over-all weight of the ship.

GENERAL ELECTRIC

952-89-211

ILLINOIS TECHNOGRAPH

NOV 16 1942
UNIVERSITY OF ILLINOIS

OCTOBER

1942

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Stabilized Soil

Battle of Brains

A. S. C. E. Smoker

Tau Beta Pi Theme

Names in the News

Our Societies

Technocracked

A. S. C. E. Conference

★

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Gilbert D. McCann, Ph.D., M.S.
...Master of Thunderbolts, too!

MODERN FARADAY CAGE. Three million volts of man-made lightning hit a car in Westinghouse High Voltage Laboratories, while Dr. Gilbert D. McCann sits safely at the wheel. Dr. McCann . . . co-inventor of the "fulchronograph" for timing and measuring the intensity of thunderbolts . . . joined Westinghouse in 1939, after receiving degrees of M.S. and Ph.D. at the California Institute of Technology.

EVERY TIME you take a breath, 175 thunderbolts crash to earth somewhere.

These lightning strokes, streaking down at 600 million miles an hour, are charged with torrents of electrical power . . . as much as 200,000 amperes, at pressures as high as 25,000,000 volts.

No wonder protection against lightning has been a major problem to utility companies . . . such a problem that, up to a few years ago, lightning frequently shut down power service to industry.

Today, a properly designed power line is not likely to be put out of service by lightning *more than once in 5 or 10 years!*

Dr. Gilbert D. McCann and Charles F. Wagner, Westinghouse engineers, have done much to make this possible through their studies of natural thunderbolts and laboratory lightning.

One of their contributions is the "fulchronograph" which automatically times natural lightning strokes and measures their intensity. Oscillographs and movie cameras also are used to photograph the celestial fireworks.

These mechanical "eyes" . . . perched high on the top of scores of tall buildings, smoke stacks, and transmission-line towers . . . are constantly collecting facts about lightning phenomena that were never known before. Facts about "cold" lightning, of terrific blasting power. Facts about "hot" lightning, the incendiary bomb of the sky.

Still further knowledge is gained from the study of *artificial lightning* . . . made in the Westinghouse High Voltage Laboratories. This man-made lightning is used to bombard insulators, lightning arresters, and other protective devices to test their efficiency.

These studies are constantly adding to the store of "know how" in the field of power transmission. As a result, Westinghouse engineers have been able to design and build lightning arresters and ground-wire systems that tame the wildest thunderbolt.

The work done by Dr. McCann is contributing mightily to America's war effort by helping to keep electric power flowing night and day to our vast war industries . . . as well as by protecting ordnance plants from destruction by lightning.

America needs scientists and engineers as never before . . . to help solve the technical problems of modern warfare and to rebuild the world when the last shot is fired.

Nearly 300 young engineering graduates joined Westinghouse last Spring to carry on this work. In the Class of '43 there will be many graduates who will have an equal chance to help win the war . . . and the peace to come . . . with Westinghouse.

Westinghouse

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, PITTSBURGH, PENNSYLVANIA • PLANTS IN 25 CITIES — OFFICES EVERYWHERE

OCTOBER ★ 1942

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THE TECHNOGRAPH

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Published Eight Times Yearly by the Students of the College of Engineering, University of Illinois

Published eight times during the year (October, November, December, January, February, March, April, and May) by The Illini Publishing Company. Entered as second class matter, October 30, 1921, at the post office of Urbana, Illinois. Office 213 Engineering Hall, Urbana, Illinois. Subscriptions, $1.00 per year. Single copy 20 cents.

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The cover cut is through the courtesy of the Westinghouse Electric and Manufacturing Company. The picture shows the oil well drilling rig, drilling for oil on the Mississippi Delta in Louisiana. The drilling equipment is driven by electric motors. Four 200 Kw. generators furnish the power for the motors.

★

The frontispiece this month is a picture of four giant air cooled broadcasting tubes. Cut courtesy of Westinghouse.

STABILIZED SOIL

By J. S. CRANDELL

Professor of Highway Engineering

To build your house out of your own cellar excavation seems to many people to be a sort of Alice-in-Wonderland trick. But it is being done, and the resulting house is excellent. Hundreds of years ago the Indians of our southwest and of Mexico built adobe houses, and the descendants of those men are living in the same homes today. It is doubtful if there are any dwellings in the rest of the world that are as old and still in use.

But—if long drenching rains should attack those adobe houses, or if the rivers suddenly rose and encompassed them, the mud that they are built of would soon be washed away, and the houses would be a bad dream. There are mud housese in Kansas, Wyoming and other western states that have lasted well if they have had good roofs to deflect the rains; these are known as sod houses. There are many people in the United States today who were reared in these sod houses. They are strong advocates of such construction, for, as they say, a sod house is cool in summer and warm in winter, and its cost is almost nothing. Why don't we build more of them?

Side view of the four-room adobe home built on Poplar Grove Plantation in Adams County, Mississippi in 1939.

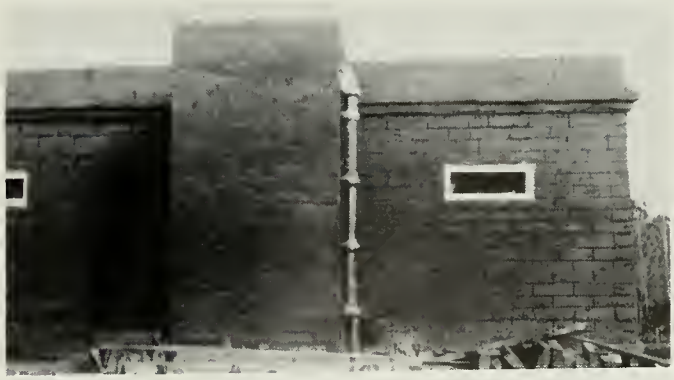
The sod houses that have heretofore been built have been makeshifts. No one who knew anything about architecture ever designed them, and the crudest methods were used in their construction. They are, for the most part, ugly, ungainly, and ill-suited to our 1942 ideas of gadgetry. If we could make our mud housese waterproof so that they might look more like the general line of homes we would attain our end of building a home that would give us just what we long have wanted — something for (almost) nothing.

We now have done that. We have stabilized the mud. We have made it waterproof, and at a minimum cost. We have added a small amount of a bituminous material, known as asphalt emulsion, to the earth we can dig up almost anywhere, and the result is a water-proof, temperature-proof, rat-proof, bug-proof, snake-proof, fool-proof building material. Any man, if he isn't too lazy, can make an excellent home, garage, chicken coop, hog house, tool shed, or other building from his own back yard. We have a bulletin, No. 333, Experiment Station of the University of Illinois that tells you just how to go about the work. It was written by Mr. E. L. Hansen who investigated many emulsions, many soils, and laid up many building blocks in order to determine what was best. He determined that the soil should have about a quarter of its bulk in fine materials, and that about 10 per cent of asphalt emulsion should be added. This mix is made in as small sized concrete mixer. The earth then can be tamped into forms for the walls, or it can be made into blocks or bricks. The latter can then be laid up just as is done with concrete blocks. If a cellar is dug first, then a wooden floor is laid for the ground floor, and the cellar floor is laid with stabilized earth.

Photo of a four-room dwelling house built of stabilized brick in Mississippi.

Window frames and doors are made of wood, and these can be bought from any carpenter shop, or by mail from mail-order houses. The roof is cheaply made of planks overlaid with tar or asphalt and roofing paper. This

(Continued on page 14)



Rear view of corn-potato house, showing windows for light and ventilation. A cistern built of 4x8x18 inch stabilized adobe bricks is used to catch rain water from the roof for farm use.

E.E.'s Brain Trust Smashed by M.E.'s

By DEAN MADDEN, M.E. '43

E. E. Line-up . . .

Parker Ellsworth
Pete Fenoglio
George Oberle
Richard Shoulders

M. E. Line-up . . .

Paul Salerno
Bob Kraft
Robert B. Browne
Dean Madden

On October 7 the sparks flew and the wind blew as the sons of Faraday took on the superheated power house boys from the Mechanical Engineering Lab in the annual Battle of Brains. The reason being to settle the long and heated debate of whether electrical engineers with their high frequency brain cells were at match for the smooth running and well oiled involute gears which are constantly clicking in the heads of the mechanical engineers.

Professor A. R. "Buck" Knight, a prejudiced but well meaning and harmless Electrical Engineer, was the master of ceremonies and did an excellent job of "Kay Kisering" the whole affair. It was Prof. Knight who first originated the idea of this contest three years ago and who donated the famous "Buck Knight Trophy" which has become the symbol of intellectual superiority in the College of Engineering.

This trophy consists of a thimble with a collar button as a base and two pieces of copper wire as handles. There is a very significant meaning to the parts of the trophy. The thimble is a symbol of industry. The collar button signifies the eternal search, and the copper handles signify flexibility and adaptability. These are all qualities you will find in a successful engineer.

The questions, which were strictly non-engineering of the L.A.&S. type were submitted by various members of the faculty who seem apt at asking embarrassing questions. Among some of the questions asked were found these brain-teasers.

1. In what department of the University of Illinois would be following courses be taught? a) Cosmetics, b) Institution Management, c) Comparative neurology, and d) Ovid.

A group of jubilant M.E.'s and others inspecting the trophy being held by Paul Salerno.

Vernon Rydbeck, president of A.I.E.E., presenting the coveted "Buck Knight Trophy" to Paul Salerno, president of A.S.M.E., as Professor Knight looks on. (The score, incidentally, was 110 to 129.)

2. Sixth and John Street is to Wright and Green Street as Mathews and California is to ———— and ————?

3. In which of the following is "contumely" correctly used: (a) The shy girl behaved decorously and contumely. (b) A fashionable young matron should dress herself contumely. (c) Because of contumely he was charged with contempt of court.

4. Name the composers of the following operas: (a) Barber of Seville, (b) Scherazade, (c) Tannhaeuser, (d) Aïda, and (e) Mikado.

5. Idetify the following men prominent in foreign countries: (a) Nehru; (b) Serrano; (c) Hu Shih; and (d) Castillo.

Answers to these questions will be found at the end of the article. Test your own knowledge by writing down what you know and then looking at the answers. It is obvious that the contest was a real test of the mental capacities of the combatants.

The battle raged with a fury only excelled by Stalingrad with each side slugging and punching toe to toe. At the end of the first round the defending champions were in the lead, but by the half the fighting power house boys finally had gotten their steam up and had forged into the lead. They never lost it. Their redesigned supercharger (The details of which are a military secret) had done the trick. They had won the "Buck Knight Trophy."

Broken hearted and dejected Jay Hinchcliffe of the A.I.E.E. presented Paul Salerno, president of A.S.M.E.,

(Continued on page 11)

COMMUNICATIONS
. . . directing arm of combat

"Get the message through!" That's the tradition of the men who wear this insignia. Of the 18,000 Bell System people now in the armed forces, nearly 4,500 are with the Signal Corps. Young men can serve their country and obtain specialized training in communications in this great branch of the Army.

...and Western Electric equipment goes to every battle front

Army planes fly and fight with Western Electric radio command sets, which keep the planes of a squadron in contact with each other and with the ground forces.

Wherever American soldiers fight in tanks, they get their orders over Western Electric radio sets—vital in coordinating today's mechanized warfare.

Observers report front-line action to Army commanders over Western Electric field telephones, field wire, field switchboards.

A major source for this specialized equipment is Western Electric—for 60 years manufacturer for the Bell System—one industry with over 70,000 skilled men and women dedicated to *"keep 'em in contact."*

Western Electric

ARSENAL OF COMMUNICATIONS

ARMY E NAVY

A. S. C. E. Annual SMOKER

By WILLIAM G. MURPHY, C.E. '43

This meeting of the A.S.C.E. was typical of most of the first meetings of the departmental organizations all over the campus

One part of the program in which everyone took a very active part was refreshment time.

Sterling Snyder, president of the A.S.C.E., passing out cigarettes to the members.

Under the direction of the new president the American Society of Civil Engineers held their annual smoker last week. The meeting marked the beginning of what promises to be a new era in the affairs of the society. Slide rules and scales were noticably missing as the "boys" got together for one of their few nights out of the year. Sam Wiley '43 was program chairman for the evening.

Sterling Snyder '43, president, opened the program by welcoming the new members and introducing the officers of the organization for this semester. The officers are: Bud Christianson, vice president; Marianna Schroeder, secretary; and Eugene Estes, treasurer.

Prof. Harold E. Babbitt, speaking on the reasons why we should belong to ASCE was the first speaker on the program. Bud Christianson '43, president of Chi Upsilon followed Prof. Babbitt with a short talk on engineering honoraries. His talk was designed to let the freshmen and sophomores know that there were honorary organizations on the campus north of Green St.

Dean Enger, head of the engineering school, talking to two senior C.E.'s.

Sheldon Leavitt '43½, gave a short explanation of the new department in the organization which will give the freshmen more benefit from the organization. A council is being organized which will arrange programs and entertainment especially for the new members of the society.

Dean H. H. Jordan gave a brief talk on the draft and its effect on the engineering students. A committee is working with the university and the government that attempts to secure deferments for the students and the engineers are in a high spot on the list of those getting deferments. As soon as you hear from the draft board in your community let the committee know about it.

The high spot on the program was the talk by Col. L. C. Sparks, Commandant of Cadets at the university. The colonel enthusiastically praised the American soldier and gave his opinion that we are following the right path to victory. He stated that this summer would have been ideal as far as morale and economics were concerned to open a second front, but that it would have been a foolish waste of partially trained men.

The last part of the program was impromptu since it became necessary to kill time between the speakers and the refreshments. The professors present were asked to introduce themselves by a short story about when they were in school. I believe that everyone present will say that the men in the Civil Engineering Department are good sports and they did pretty well in "extra-curricular" activities too.

Refreshments were served to top the evening which was one of the most successful in the organization's history.

E. E., M. E. BRAIN BATTLE

(Continued from Page 8)

the coveted award as newsmen and photographers went wild.

The judges in whose hands the fate of the contestants lay were Dean H. H. Jordan, Professor Babbitt of Civil Engineering, and Professor Lansford of the T.&A. M. department.

Highlight of the humor of the evening was when the question was asked, "What is a fresh-water college?"

(No. 1 M. E.) snapped back, "A school of fish", which promptly blew four fuses in the E. E.'s circuit.

☆ ☆ ☆

Here are the answers to the quiz questions.

1. (a) Pharmacy, (b) Home Economics, (c) Anatomy, and (d) Classics (Latin).

2. Goodwin and Illinois intersection.

3. Because of contumely (insolence) he was charged with contempt of court.

4. (a) Rossini, (b) Rimsky-Korsokoff, (c) Wagner, (d) Verdi, and (e) Sullivan.

5. (a) Leader in India, (b) ex-foreign minister of Spain, (c) ex-ambassador from China to the United States, (d) President of Argentina.

TO THE FRESHMEN . . .

I've found three things hard to do in my life: one was to climb a fence leaning towards me, another was to kiss a girl leaning away from me and the last is to make a sales talk. I have done the first, I won't commit myself on the second, and I'll let you be the judge on the last.

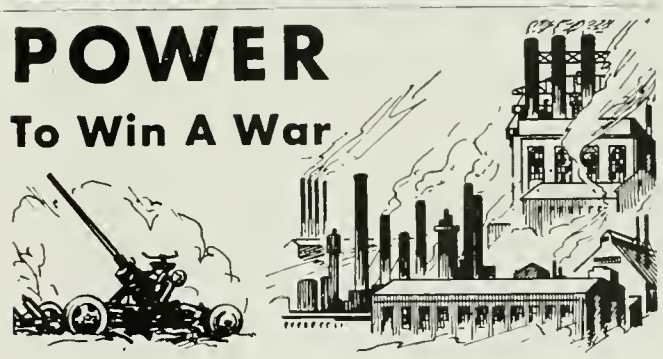
I want to say to all the new freshmen that you have picked the hardest field of endeavour on the campus, but you were fortunate in picking the finest engineering school in the country. It is easy to prove that statement without getting very technical. When you first came to the campus you saw several students representing countries in four corners of the world. They didn't take the trouble to come here because of the women on the other side of Green Street —that you probably found out your first day too.

Getting serious for a minute we of *The Technograph* staff realize the reputation of our college and we would like to do our part to uphold it. With your support of the magazine we can. All the good things in engineering aren't down in text books yet; we attempt to give you some of those and in addition we hope to help you pick your field in engineering so that you will be able to move right along in your curriculum.

Another thing you probably noticed was the big building shaped like an I over in the northwest corner of the campus. Get over there to look around the first chance that you get. No one minds your looking around as long as you don't tear up some $50,000 experiment or push a lever on the 3-million pound testing machine.

Don't let any upper classmen fool you into thinking that they know how to use all the scales on the big slide rules that everyone carries. I can tell you right now that you don't need a 10 inch log log decitrig slide rule, but you might as well get one since people will refuse to give you credit for being an engineer unless you carry one.

Did any of you know that Moses was an engineer? The Bible (still the best seller of all time) says that he smote the rock and water gushed forth.



One of many new Allis-Chalmers
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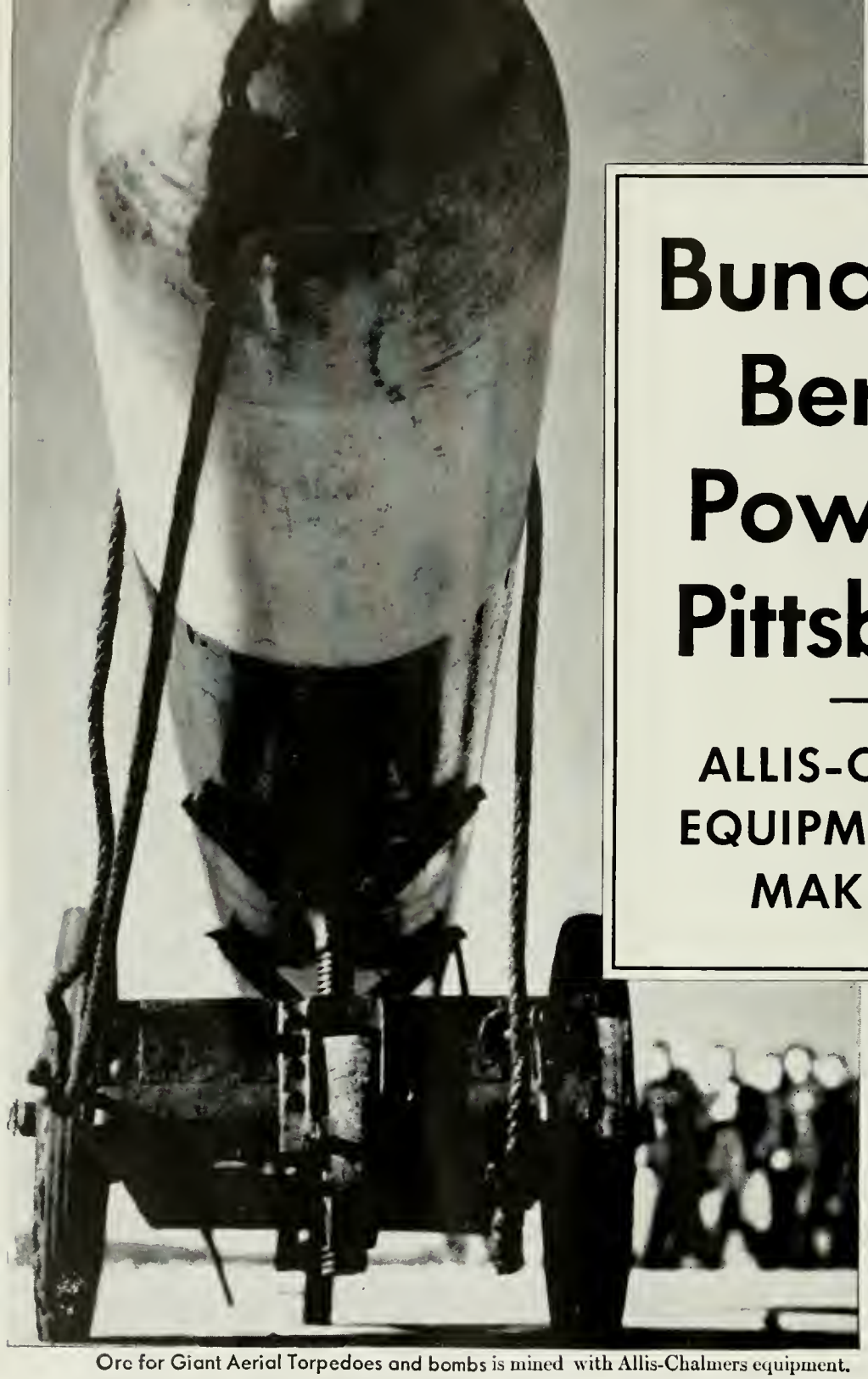
ALLIS-CHALMERS EQUIPMENT HELPS MAKE BOTH



Ore for Giant Aerial Torpedoes and bombs is mined with Allis-Chalmers equipment.

"A. HITLER, BERLIN, GERMAN
That's what we'd like to label just one o
thousands of tons of ore which Allis-Chal
equipment is helping to mine and turn
aerial torpedoes and bombs!

And that turbine above is another A
Chalmers product that will soon be tur
out trouble for Hitler—supplying powe
great war plants—helping to make Ameri
soldiers the best equipped in the world.

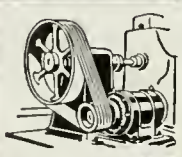
These are just two examples of how t

ALLIS-CH

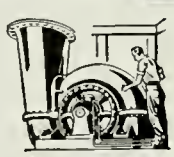
OFFERS EVERY MANUFACTURER EQUIPMENT AND ENGINEERIN

ELECTRICAL EQUIPMENT

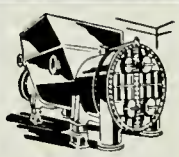
STEAM AND HYDRAULIC TURBINES



MOTORS & TEXROPE V-BELT DRIVES

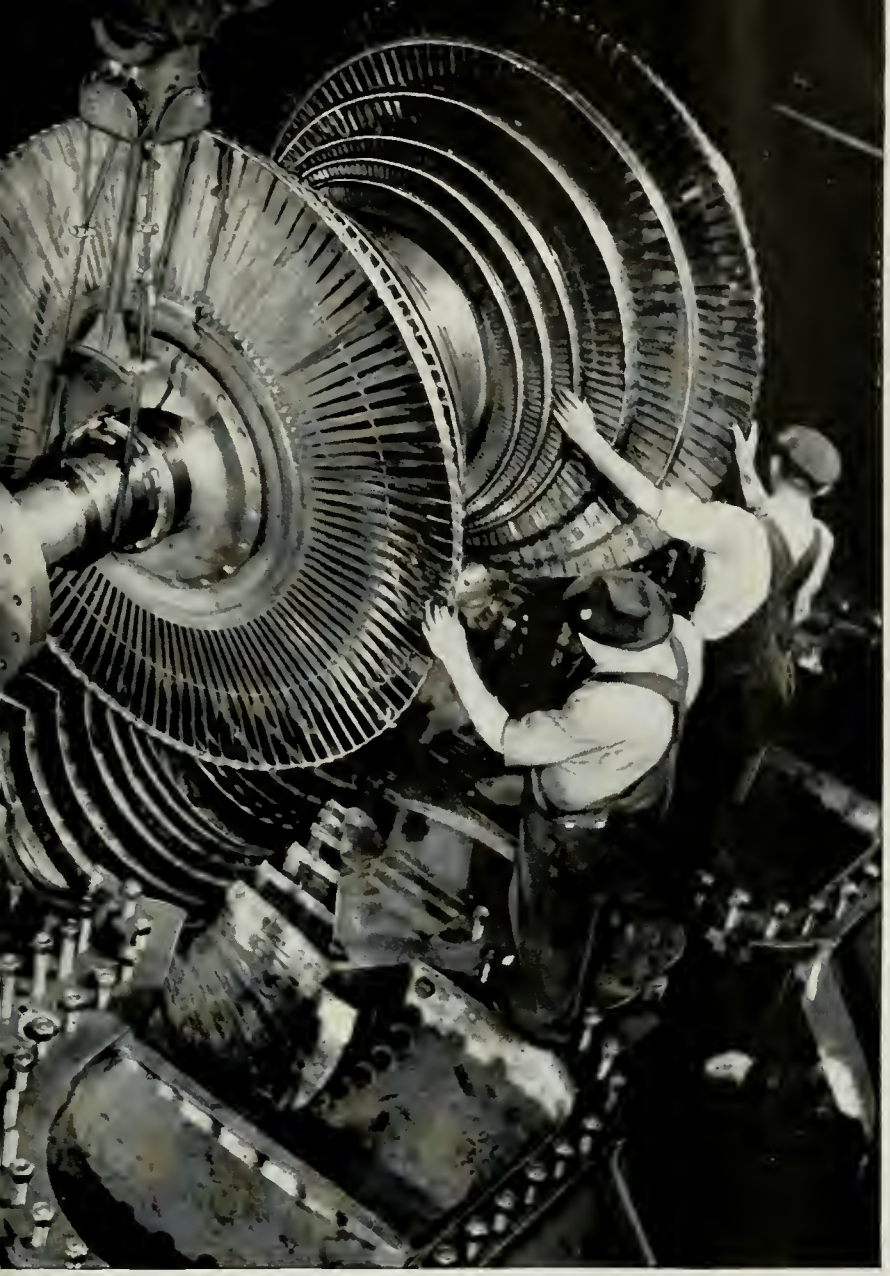


BLOWERS AND COMPRESSORS



ENGINES AND CONDENSERS

CENTRIFUG
PUMPS



of Allis-Chalmers people are fighting
xis—are *working for Victory!*
er 1,600 Allis-Chalmers products are
ng in the Battle of Production. And our
erative Engineering service is helping
rs *produce more*—not just with new ma-
, but with *machines now on hand!*
s production experience will be of added
when the war is over. We work for
ry—we plan for Peace!
-Chalmers Mfg. Co., Milwaukee, Wis.

8 out of 10 loaves of bread in U.S. are made with the aid of A-C farm and flour mill equipment.

VICTORY NEWS

Washington, D. C.—Keels for more than 140 "Liberty" ships have been laid and more than 60 ships have been launched from ways which did not even exist before 1941. Original schedules have already been more than doubled.

To set the fastest shipbuilding record in history, mass production principles are used. More than 500 makers are feeding parts to Liberty ways.

From Allis-Chalmers, one of the most important of the contributing firms, comes products ranging from machine-gun cooling pumps to propulsion shafting.

Three-Stage High Speed Pump is inspected as it leaves A-C shops for a military destination. Equipment includes Allis-Chalmers motors and switchgear.

Milwaukee, Wis.—Mosquito boats no longer have to use their motors to recharge their batteries—small Allis-Chalmers rectifier units now do this job.

This unit is the newest means of obtaining nominal d.c. current from existing a.c. power lines. It eliminates need for keeping ships motors running for battery charging on shore. It also aids coast defense by helping to supply power for shore searchlights.

Industrial plants are also using the new unit to supply small amounts of d.c. for individual drives on planers and other machines, in laboratories for testing purposes, and in tool rooms.

FOR VICTORY
Buy United States War Bonds

ALMERS

WE WORK FOR VICTORY — WE PLAN FOR PEACE

ATION TO HELP INCREASE PRODUCTION IN THESE FIELDS...

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CHEMICAL PROCESS EQUIPMENT

CRUSHING, CEMENT & MINING MACHINERY

BOILER FEED WATER SERVICE

POWER FARMING MACHINERY

INDUSTRIAL TRACTORS & ROAD MACHINERY

The Value of Cultural Subjects
. . . TO THE ENGINEER

By PAUL SALERNO, M.E. '43

Each spring, the pledges to Tau Beta Pi compete with other pledges all over the country in a theme writing contest. This was the prize-winning theme chosen to represent the Illinois chapter in th national contest

The engineer of today has secluded himself in a narrow field of specialization, sometimes losing sight of even the effects of his own work upon the world surrounding him. He cares little and knows little of cultural subjects, probably believing that broad knowledge of the fine arts, literature, history and philosophy is incompatible with his own branch of knowledge.

An appreciation and interest in these subjects enriches the personality, teaches higher standards of taste and morals, instills qualities of leadership and promotes good citizenship. In art and literature is the revelation of genius; the results of a creative mind. The engineer possesses a sense of values which enable him to appreciate the highest attainments in any field, and although the very best in music and literature is available to everyone, he denies himself the many hours of entertainment and pleasure which might be his. The engineer should learn to live as well as earn a living. He should learn to appreciate the subtle values of life as well as the material.

It is unfortunate that time for cultural studies in the undergraduate engineer's curriculum is unavailable. If there were time, however, it would be difficult to arouse cultural interests in a mind which sets such great store by the practical. It is necessary that the student himself realize the benefits resulting from a study and appreciation of cultural subjects. He can grasp the significance of world events and learn to rationalize and reason only through such study and appreciation.

A mere knowledge of facts pertaining to cultural subjects is insufficient. It is necessary to differentiate between knowledge and wisdom. Knowing that Beethoven's *Fifth Symphony* is musically of a higher caliber than *Rose O'Day*, or that the Cathedral of Notre Dame is a better example of Gothic architecture than the Tribune Tower, is knowledge but knowing why constitutes wisdom. Since the world is looking more and more to the professional man for leadership and inspiration, wisdom becomes a necessary quality. A profession which is enjoying the growing esteem of society cannot afford to admit inferior men. Today the engineer must be a judge of social, political and ethical situations as well as technical problems. This calls for a higher type of personality than was formerly thought adequate.

The complex social and economic problems of the present can be analyzed through an understanding of the problems of the past. The world has progressed in the field of science since the time of Aristotle. We know that the science of that day is false, but the political and social problems remain the same. For example, the historian realizes that the happenings of the last few years are a re-enactment of the Peloponnesian Wars and that unemployment and strikes were problems of antiquity as well as of today. It is revealing to discover that men in the past faced their problems with clear vision and fortitude.

The study and resulting appreciation of cultural subjects has a more significant influence upon the engineer than the enrichment of his personality or the instillation of qualities of leadership and good judgment. An educated and cultured professional group forms a bulwark against the evil effects of totalitarianism. Governments which emphasize the extreme importance of race, state, or class subdue personality and individual achievement and utilize the neutral forces of science and technology for vicious purposes. The fury and intensity of the attack which has been launched against our country is a direct result of years of misdirected scientific and technological advancement. If the democratic way of life is to survive after the present war has ended we must have a professional group possessing high ethical and moral standards. Those responsible for technological advancement must direct such advancement toward a humanistic goal. They must create instead of destroy. They must liberate instead of enslave.

STABILIZED SOIL *(Continued from page 7)*

is then coated with tar or asphalt and shingles made out of emulsified earth laid on top.

Mr. Chandler Emery, of Jackson, Mississippi, has biult a number of these inexpensive housese on his plantation, and he writes that they have all been successful. Some illustrations of these houses are shown here. In addition there are some very beautiful homes around Hollywood that have been built by this method for our movie actors and actresses. These homes are expensive, ornate, and in excellent taste. So we have from the cheapest to the expensive types built of earth, and serving their purposes alike of giving our people their homes built out of their own property.

If you are interested then get Bulletin No. 333.

You have TWO *kinds of Future*

★

The dominant consideration, now, is your immediate future. Many of you are enlisted in the reserve, or are already commissioned. You do have a valuable training which the country needs in this emergency. Make every day count in perfecting that training.

The war you will undoubtedly help to fight is not a nice war. But as we see it, the United Nations intend that it shall have not only a victorious ending, but also a hopeful ending—hopeful in the sense that we shall have a peace in which our goal shall be jobs for all men.

You have a right to know that industry is even now beginning to dream up the wherewithal for those jobs—new things to make, and new ways to make old things better.

A lot of everyday sort of men, many of them very much like yourself, doing this kind of thinking in the past, are the reason Alcoa Aluminum became the leader in the aluminum business. They are the reason Alcoa Aluminum will have such a big part in the future.

Call this kind of thinking Imagineering —letting your imagination soar and then engineering it down to earth. It is perhaps the most important talent a man can have. It is the point of view that industry will always need, and use, to make America a better place to live in.

There is no "pay-off" in this little message. We just wanted to have you know that folks like us can be completely devoted to high-speed war production, and have an eye on a good future for all men, at the same time.

A PARENTHETICAL ASIDE: FROM THE AUTOBIOGRAPHY OF

ALCOA ALUMINUM

• This message is printed by Aluminum Company of America to help people to understand *what we do* and *what sort of men* make aluminum grow in usefulness.

NAMES

. . . *in the news*

By WILLIAM R. SCHMITZ, Ch. E. '45

☆ ☆ ☆

RAY BOHMAN

Scholar, statesman, soldier, and gentleman, that is the title that rightly belongs to Ray Bohman. Ray is a Mechanical Engineer and has done very well for himself in his four years at Illinois. There are many engineers that would like to have his high scholastic average.

Ray is a member of Pershing Rifles, Scabbard and Blade, Tau Nu Tau, Phi Eta Sigma, Tau Beta Pi, Pi Tau Sigma, and is Cadet Lieutenant-Colonel of the Engineers. He is also a member of the Board of Directors of the Y.M.C.A.

Military has claimed quite a bit of Ray's time while here at the University, but he says that he has enjoyed it more than anything else. Last winter, Ray received the Chicago Tribune award for having the highest scholastic and military average among the juniors in advanced R.O.T.C. He still claims that his greatest thrill came last spring when he was one of the floor marshals for the Grand March at the Military Ball.

RAY

DALE

This fair-haired son of Alpha, Illinois has given the folks back home plenty of reasons to be proud of him. He and his roommate spend a good bit of their spare time in making and designing miniature electric motors, and they actually run. He also spends quite a bit of time over in the T.A.M. department testing railway carwheels and brake shoes. And like all the rest of the engineers on the campus, he thinks Illinois can't be beaten in engineering.

BOB ST. JOHN

That engineer you see over there behind all those test tubes, retorts, and distilling flasks, is none other than our old friend, Bob St. John, chemical engineer extraordinary. Bob is a member of Phit Eta Sigma, Omega Chi Epsilon, A.I.Ch.E., and Pierrots. He is also the junior manager of the Theater Guild.

Bob's father is also a chemical engineer and so Bob is more or less following in his father's footsteps. Sporting a very nifty 4.77 scholastic average, Bob is doing some research this semester. Right now he is working out a new catalytic process by which he can obtain butadiene for making synthetic rubber.

Bob has a variety of hobbies, and among those which he lists are: airplane flying, fishing, cooking, dancing, and sports of all kinds, especially swimming. He is also quite an expert on movies and theatrical productions. Bob has had several courses in play-directing and is well-informed on all such matters.

The new co-eds that have appeared on the campus this semester seem to be much improved according to Bob. Bob is quite a ladies man when it comes to escorting the girls around campus and taking in the social events. However, when he graduates in June, he thinks that he will go over to Ohio State to see what they have over there. He plans to get his Master's degree at Ohio State. Bob thinks the best thing he has accomplished so far is the friends he has made here at school, especially those at M.R.H.

MYRON PFEIFER

Whoever said that athletics and engineering didn't mix can go to Myron Pfeifer as a living example. Myron has earned two letters on the varsity squad, having also made his numerals as a freshman. He is a senior in the chemical engineering school with a 3.9 average to his credit.

When I went over to see Myron, I interrupted a bridge game long enough to talk to him. Bridge is one of his favorite pastimes which he finds time for now and then in the midst of his studies and football. He has acquired the nickname "Pfeif" from the fellows at the Sigma Chi house where he is a member.

Myron seems to be a steady man where women are concerned. His one and only lives just across the street in Presby Hall. She has had his pin for nearly a year now.

Concerning his plans after graduation, Myron is as uncertain as most of us who aren't in the advanced course in military. As a chemical engineer, he is deferred until graduation. After that he will either go into the army or into some chemical defense industry.

Myron hails from Illiopolis, which is right in the heart of Illinois. While in high school he also played football. His position on the team is quarterback, and he has the all-important job of calling plays. He was at the helm when Illinois made three of her touchdowns over Butler.

(Continued on page 19)

MYRON

BOB

While Victory is being won prepare for the work of peace. Learn to know your bearings.

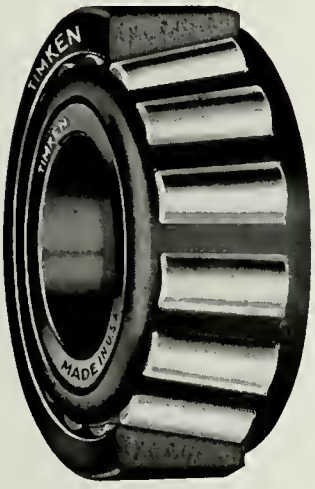
American planes, tanks, trucks, guns and warships are doing an outstanding job in the fight for freedom because, in addition to being good all-around engineers, their designers *know their bearings.*

After Victory, when we have made sure that the things our forefathers fought and died for shall not perish from the earth, "*knowing your bearings*" will be one of the most important assets you or any young engineer can possess.

For when the tremendous work of reconstruction starts, machines of all kinds will be required to have higher speeds, greater precision and endurance and be more economical to operate and maintain than ever before.

In achieving these objectives, Timken Tapered Roller Bearings will be used to an even greater extent than in the past because of their ability to meet—and beat—any and every bearing condition that might develop.

Now is the time to learn to know your *Timken Bearings.* Our engineers will be glad to help you.



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TAPERED ROLLER BEARINGS

Our Societies . . .

By BYRON WELSH, M. E. '43

TAU BETA PI

Tau Beta Pi, all-engineering scholastic honorary fraternity, started off the year with a steak fry on October 2. It was sponsored by Professor Espy, the faculty adviser, who with the help of Mrs. Espy, gave the fellows a fine feed with plenty of applie pie. Rides out to the farm where it was held were furnished by Mr. Faucett and Mr. Shedd of the electrical and civil engineering departments, respectively. A smoker for rushees was held on October 15 by the members. The officers for the year are:

Ralph R. Paxton.....*President*
Jay E. Hinchcliffe.....*Vice-President*
Allen M. Henningsen.....*Corresponding Secretary*
Robert J. Kallal.....*Recording Secretary*
George F. Asselin.....*Treasurer*
Martin Knell.....*Master of Initiation*

A. S. CH. E.

The American Society of Chemical Engineers announced their officers for the coming year.

Homer Pratt.....*President*
Kenneth R. Nickolls.....*Secretary*
Richard O. Wilson.....*Treasurer*

Their first meeting was a get-acquainted smoker at the Alpha Chi Sigma house on September 23. The faculty was introduced to the freshmen and refreshments were served. Lieutenant-Colonel Hood of the cavalry gave a talk at their next meeting on October 15.

KERAMOS

Keramos is a professional honorary fraternity for ceramists. The purpose of the organization is to foster alumni relationships, help orient freshmen, and to help around the department in any way possible. Their new officers are:

Earl Smith.....*President*
Vaughn Seitzinger.....*Vice-President*
C. Leroy Turner.....*Secretary-Treasurer*
Francis Wright.....*Warden*

PI TAU SIGMA

Pi Tau Sigma is the mechanical engineering honorary fraternity. It's faculty adviser or sponsor is Professor Macintire. The first meeting was held Thursday, October 8 in the Union Building. Plans were laid for the fall rushing, pledging, and initiation proceedings. At the head of the organization are:

George Mays.....*President*
William Mareneck.....*Vice-President*
Dale Hankins.....*Corresponding Secretary*
Oliver Schmidt.....*Treasurer*

S. B. A. C. S.

The Student Branch of the American Ceramics Society held a picnic at Crystal Lake park September 23. They had a good ball game and plenty of food. Their first regular meeting was held on October 7. Their officers are:

Poyson Shonkwiler.....*President*
Earl Smith.....*Vice-President*
Jack Graham.....*Treasurer*
Gordon Q. Johnson.....*Acting Secretary*

SIGMA TAU

Sigma Tau, another all-engineering honorary, held their first meeting in the Union Building on September 30. They discussed plans for their rushing smoker and initiation procedure. They are planning on entertainment for their meetings from off the engineering campus. The officers for the coming year are:

Otto Johnson.....*President*
Ben Muirheid.....*Vice-President*
Martin Knell.....*Secretary*
Byron Welsh.....*Treasurer*

M. I. S.

The Mineral Industries Society is a departmental organization affiliated with The American Institute of Mining and Metallurgical Engineering. Their first meeting was on October 1; the purpose of which was to acquaint all underclassmen with the faculty and the facilities of the metallurgical engineering department. Refreshments were served. Their leaders for the year are:

Gus Simpson.....*President*
Keller Phillippe.....*Vice-President*
Charles Bate.....*Secretary*
Jim Haley.....*Treasurer*

A. S. C. E.

The American Society of Civil Engineers started off their year with a successful get-together smoker on October 3. As part of the program, the seniors led group singing. The freshmen were introduced to the faculty and the officers who for the coming year are:

Sterling Snyder.....*President*
Bud Christiansen.....*Vice-President*
Marianna Schroeder.....*Secretary*
Gene Estes.....*Treasurer*

A. S. M. E.

The officers of A.S.M.E. at the present time are:

Paul Salerno.....*Chairman*
Bill Mareneck.....*Vice-Chairman*
George Mays.....*Treasurer*
Robert Tuell.....*Secretary*

At their first meeting Professor Leutwiler and Professor Espy each gave a short message to the new members and old explaining the benefits of the organization and also it's function. At their next meeting which was held on October 21, technicolor movies on the production of steel were shown.

A. I. E. E.

The American Institute of Electrical Engineers, the departmental organization for the E. E.'s, is headed by the following officers:

Vernon Rydbeck.....*President*
Donald Henry.....*Vice-President*
Jay Hinchcliffe.....*Secretary*
Bob Krieger.....*Treasurer*

They had their usual freshman welcome on September 23 where they met the faculty. The freshmen were entertained by the seniors with a skit about studying for an E. E. 25 exam.

A. S. A. E.

The American Society of Agricultural Engineers is open to any student with six hours of Ag. Engineering. They started the year off with a picnic with the new members at Professor Lehman's home. Professor Lehman is the head of the Ag. Engineering Department. The organization is ably guided by the following officers:

Ben Muirheid.....*President*
William Graves.....*Vice-President*
Gilbert North.....*Treasurer*
Murray Fourth.....*Secretary*

CHI EPSILON

The civil engineering honorary, Chi Epsilon, held their first meeting on September 29. Their officers for the year are:

Bud Christiansen.....*President*
Bill Schacht.....*Vice-President*
Ray Ackerman.....*Secretary*
Homer Wong.....*Treasurer*
Dan Bechly.....*Editor of Transit*

Many of their speakers this year will talk on non-technical subjects. Also they are planning a fall picnic before its gets too cold. Initiation plans are also under way.

NAMES IN THE NEWS

(Continued from page 16)

He remarked that the football team was doing a lot better than most people expected it would. Although he liked "Zup" very much and thought he was a good coach, he thinks Eliot is an excellent man to replace him. He also said that the team is behind Eliot one hundred per cent.

DALE HANKINS

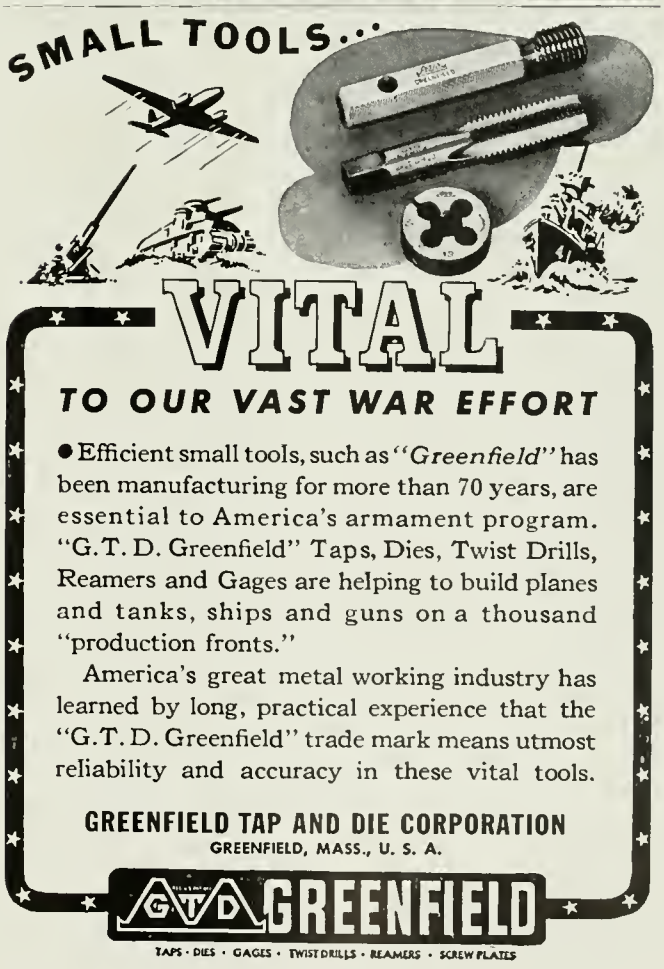
From north of Green street we have another man who has made good in activities; namely, senior track manager. We are speaking of Dale Hankins, a senior in mechanical engineering. He is a member of the Athletic Council, Sachem, Mawanda, Pi Tau Sigma, A.S.M.E., and has been president of his fraternity, Zeta Psi.

Dale's home town is one of the tri-cities, Moline. While in Molin High School, he played basketball for two years, participated in dramatics, and was associate editor of the yearbook. His hobby is sports of any kind, especially swimming and badminton.

He spent an interesting summer working at Pratt and Whitney Aircraft Company in East Hartford, Connecticut. His work gave him an opportunity to observe all the workings of a large plant. He was in the factory payroll rating department whose job it is to rerate wages according to different requirements. Some of the considerations are skill needed, experience needed, type of education needed, value of the tools used, and the physical strain on the employees.

Dale got acquainted with engineers from other schools doing the same class of work and made many friendships. Their social activities were somewhat limited due to the fact that they were in the center of gas rationing. They did make a few enjoyable trips to New York and the ocean, however.

Dale's 4.0 average was instrumental in getting him a 2-A classification which will allow him to finish school. He is very anxious to graduate, but after that he will either go into industry or a branch of the service depending entirely on Uncle Sam.



THE ILLINOIS
TECHNOGRAPH

It's all Yours . . .

ADVANTAGES:

Provides general and specific information concerning all fields of engineering.

Introduces activities and accomplishments of your fellow classmates, faculty, alumni, and leaders in industry.

Presents news selected and prepared for engineers.

MATERIALS OF CONSTRUCTION:

The thought and spirit of engineering students at Illinois.

FOUNDATION:

With engineers since 1885; that ought to make it sufficiently permanent.

YOUR OWN engineering college publication. Its success is determined by the support you give it.

SUGGEST — CRITICIZE — JOIN THE STAFF — SUBSCRIBE
CONTRIBUTE ARTICLES — PATRONIZE OUR ADVERTISERS

A. S. C. E. CONFERENCE

The first annual Midwestern Regional Conference of the Student Chapters of the American Society of Civil Engineers at Wisconsin Universty started off with addresses of welcome by Dr. Daniel Mead and Dean Thompson at 10:00 Friday morning, May 1, 1942. Dr. Daniel Mead is probably, since Professor Talbot's death, the most noted and loved Civil Engineer in United States and is a past president of the A. S. C. E. Dean Thompson is the present dean of the Wisconsin Engineering School. Their addresses were inspiring and were very enthusiastically received. At the conclusion of Danny Mead's talk he passed out cards with this inscription:

"THE SUCCESS FAMILY

The father of success is—
Work

The mother of success is—
Ambition

The oldest son is——
Common Sense

Some of the other boys are—
Stability
Courage
Perserverance
Honesty
Thoroughness
Foresight
Enthusiasm
Cooperation

The oldest daughter is—
Character

Some of her sisters are—
Personality
Cheerfulness
Loyalty
Courtesy
Care
Economy
Sincerity
Harmony

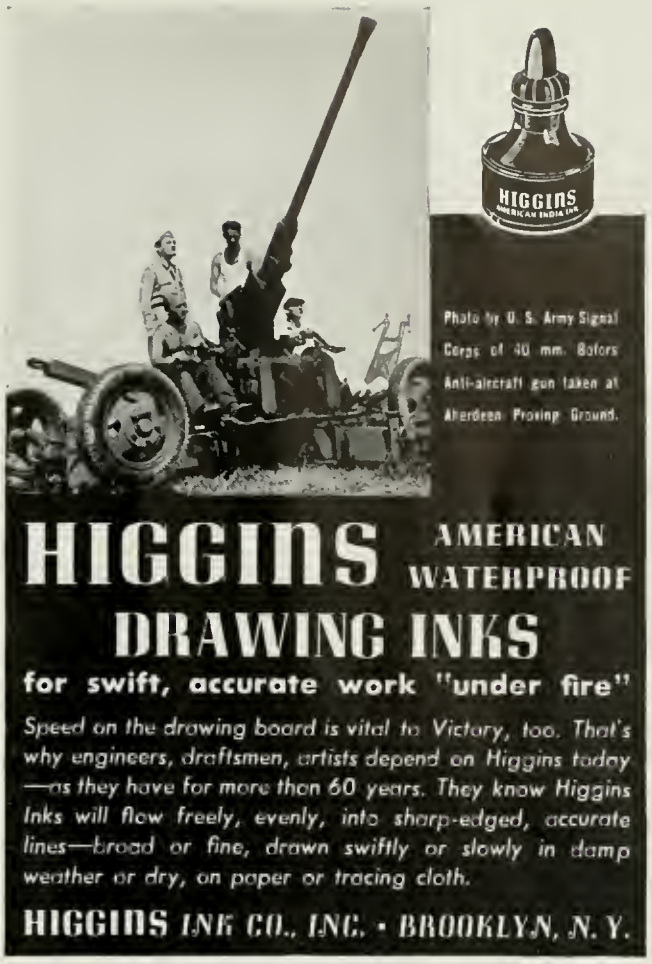
The baby is—
Opportunity

Get acquainted with the "old man" and you will be able to get along pretty well with all the rest of the family.

—Anonymous"

Dr. Mead's parting words were "Don't take yourself too seriously and don't take anybody too seriously".

Following the welcoming address we heard Dr. Edgar End of Marquette University lecture and show slides of "The Physiological Problems of High Pressure Work". Dr. End has contributed greatly in this field. From experiments, he found out that divers could go almost twice as deep by mixing helium in the oxygen they breath under great pressures as compared with the old mixture of nitrogen with the oxygen. The old record of a 220 foot descent is now broken with a 420 foot descent. High pressures have a mental effect on divers, who, according to Dr. Ends, are screwy people anyway. One of the best divers in the British Navy was so affected by pressure that he tried to unscrew the bolts holding his helmet on with the idea of crawling thru the small hole thus created



(this is not humanly possible) and then climbing up the air cable to the surface of the water. Another diver sent down to look at a sunken boat tied himself to the boat and then demanded to be pulled up.

If it were not for Dr. End and his discovery of the use of helium in diving, the submarine "The Squalus" would not be operating in the Pacific today. The present name of this submarine is "The Sailfish".

The above ended the program for Friday morning and we then took luncheon at the Wisconsin Wesley Foundation. President Elwyn King '42 introduced the speaker, "Parson Jim" Flint, by saying that Mr. Warzene of the Wisconsin Chapter said he was a "damn" good preacher whereupon "Parson Jim" said he didn't know how Mr. Warzene knew that, as he never came to church. Parson Jim's after dinner talk was highlighted by stories of his recent trip over the big pond. The ship he was on ran into a heavy sea about three-fourths of the way over. Some of the passengers went up on the deck to watch the fury of the sea and one, a little girl, was washed overboard. Any attempt to save her by lowering a lifeboat was impossible and no lifebuoy that was thrown came near her. With superhuman effort, he made the rescue. As he swung his foot over the rail of the ship, a reporter rushed up and exclaimed "You are the greatest hero I have ever seen, what are your first words?" With his chest heaving for air the man wiped the water off of his face and eyes and answered, "Who pushed me overboard?"

Because of the national situation the afternoon was devoted to a symposium on "Aerial Bombardment Protection" by Professor R. J. Roark, University of Wisconsin; Mr. John Messmer, Construction Superintendent of Mil-

(Continued on page 22)

TECHNOCRACKED . . .

By PAUL SALERNO, M. E. '43

Enthusiastic freshmen, smart-aleck sophomores, complacent juniors, and very bored seniors are in evidence on the engineering campus again this year. There is a difference, though, in the boys that went to summer school. They look a bit more shopworn than those of us that worked (?) this summer.

This department is amazed at the active participation of the engineers in politics in the past two years. When Tom McEneely, M. E. '42 discovered that the engineers could swing an election and put John McIntosh for class president last year, the wise politicos south of Green street have followed suit. This year they had Bob Alexander running for vice-president on the Liberty Party ticket and Bud Christiansen, C. E. and Bill Mareneck, M. E. running for president and vice-president, respectively, on the infant Surprise party ticket. Bud didn't know until two days before that he was running. Wow, what a surprise! He went to each sorority personally and made a campaign speech. Too bad about the surprise party. We would have liked to see two engineers in office instead of one.

We've been wondering what sort of vitamin capsules Bill Maraneck uses. He can be seen almost any night with a female companion, and yet his university average is 4.95. Wow!! Bronze tablet, here we come!

The university is contributing to the scrap metal drive in a big way. Witness the piles of scrap at various places on the engineering campus. We understand that more than one instructor was forced to hide some of his pet equipment from the searching eyes of the scrap hunters. Still, the drive was probably a good thing. Notice how clean the crane bay in Talbot lab looks.

We found out the other night that the materials rubber shortage has caused more trouble than one might suppose. The girl friend said she found herself trying to unfasten her liquid stockings from the girdle that she gave to the scrap rubber drive a month ago.

When asked why girls don't wear cotton stockings, she answered, "Don't you know what happens to girls who wear cotton stockings?" We answered no.

"Nothing," she said.

It is usual at this time of the year for the conductor of this column to give some sage advice to the incoming freshmen. Here goes. Bidwells is the best place for candy. At least it was until they put a window in the back room. Stay out of Hanleys on a Saturday night. You won't be able to compete with the sailors. Don't bother to go over to the 608. It's closed.

Don't be discouraged if you can't get a date some night. Remember, that if you divide the number of males on this campus by the number of women, you will come out with approximately 3.42687 (slide rule calculations).

In addition to the W.A.V.E.S. and the W.A.A.C.S., we now have the W.E.E.D.S. These won't effect your hay fever, though. Their full title is Women's Emergency Engineering Drafting Service. (Incidently, this isn't the 1-A type of drafting that we are talking about.) This is really on the legit. We know a couple of W.E.E.D.S. up in Chicago.

Because the senior inspection trips are no longer possible, some of the senior M. E.'s were considering seriously taking a few kegs over to the basement of the Abbott power plant and spending the equivalent time there. Hm, not a bad idea.

A. S. C. E. CONFERENCE

(Continued from page 21)

waukee County; and Mr. J. G. Kessler, Fire Prevention Engineer of the State of Wisconsin. The types of bombs discussed were the 500 pound demolition bomb, the 30 pound fragmentation bomb and the 2.2 pound incendiary bomb. Of these the most economical and also the most effective destroyer is the incendiary bomb. Engineers in this field have developed basic formulas with which to calculate the action and characteristics of these bombs. Knowing that we would not remember the formulas and the different graphs between Blast Pressure and Time, the whole discussion was summarized by saying that it was not economically practical to build structures to resist bombs.

The evening banquet was held in the Old Madison Room of the Wisconsin Memorial Union. The speaker was Pat Norris a well known after-dinner speaker and his topic was "Supersonic Sound Waves". Mr. Norris, a Wisconsin graduated engineer, gave us a very humorous definition of a Decibel and told of some of the funnier incidents of his school days. These well placed technical jokes made us engineers feel right at home. By this time everybody was in a mirthful mood and the talk was just getting started. Since a paper record of this hour that Freddie Horton '43 will always be laugbing about might reveal some *trade secrets*, it will have to be stricken from the records.

After the banquet came the ball, the most successful event of all. According to the boys the blind dates were good looking and nice and here we must again pay a tribute to the Wisconsin A. S. C. E. Student Chapter for the care and work they went to in arranging this and also the other parts of the program. Without a doubt this was a remarkable feat, for absolutely every part of the program went off without a hitch.

Saturday morning was spent with talkies on "Unfinished Rainbows" by the Aluminum Company of America, "Defense and the Telephone" and "Safe Guarding Military Information" by the Western Electric Company and with the presentation of a paper on the "Design and Technique of Welded Joints" by Mr. Archer of the Lincoln Electric Company. Oddly enough the great development in this field has come in the last ten years just as in the High Pressure Field which was discussed by Dr. Ends. This development has been so great that it is now almost impossible with present day equipment and shielded electrodes, to make a bad weld.

The first annual Midwestern Regional Conference of the Student Chapters of the A. S. C. E. was adjourned following the announcement of the names of the officers for the next meeting which would be held at the University of Illinois and expressions of thanks to our host for the fine time we all had.

BLAZING THE WAY TO FASTER PRODUCTION

As EASILY as a knife cuts through pancakes, this white-hot oxy-acetylene flame zips through stacks of steel plates . . . turning out metal parts in a fraction of the time required by other methods.

Cutting as many as twenty plates at a time, this knife that never dulls . . . guided by positive templates . . . can follow the sharp twists and turns of highly complicated patterns. Oxy-acetylene stack-cutting saves shaping, machining, and assembly time. It produces parts of identical size and shape. It reduces scrap losses . . . makes possible substantial savings in subsequent machining and fitting operations.

Stack-cutting is only one of the many oxy-acetylene processes for cutting, fabricating, and treating metals which manufacturers are using to speed up production today. Whether cutting up scrap . . . or skinning steel alive by planing a light cut from the four sides of steel blooms as they speed down the roll table . . . or helping to shape and weld finished steel . . . the oxy-acetylene flame is a tireless worker in modern manufacturing.

Would you like to know how flame-cutting and other oxy-acetylene processes could be applied to your business? You are cordially invited to avail yourself of the store of knowledge Linde technicians have assembled over a long period of years.

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The important developments in flame-cutting—and other processes and methods for producing, fabricating, and treating metals—which have been made by The Linde Air Products Company were greatly facilitated by collaboration with Union Carbide and Carbon Research Laboratories, Inc., and by the metallurgical experience of Electro Metallurgical Company and Haynes Stellite Company—all Units of Union Carbide and Carbon Corporation.

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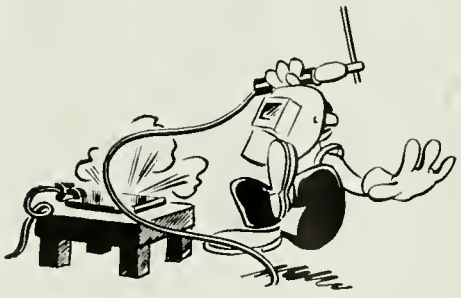
G-E Campus News

COLLECTOR

VINCENT J. SCHAEFER, of the G-E Research Laboratory, used to collect snowflakes, and because of his hobby metallurgists now have a simple method of observing details of metal structures far too fine to be seen with an ordinary microscope.

The young scientist's method of "casting" snowflakes in a film of Formvar has solved the problem of how to get a metal specimen thin enough to be examined in the electron microscope. (This device uses electrons instead of light to form the magnified images, and the electrons must pass through the specimen.)

A thin film of resin, stripped from the specimen and retaining all the details of the metal surface, can be placed in the microscope and be magnified as much as 100,000 diameters.



CALAMITY JOE

EVERYTHING happens to Joe.

And anything is likely to happen when he picks up the welder's electrode, because Joe MaGee, an animated cartoon character, doesn't know the first thing about welding. Throughout the new G-E instructional movie, "The Inside of Arc Welding," he seems to do the wrong thing.

But Joe does a good job of teaching you how *not* to strike the arc and how *not* to control the metal in the molten pool. His bungles, plus close-ups of the arcs in action, make this full-color film "one of the most helpful training aids ever offered to the welding industry."

The movie is in six parts. Each part (16 mm.) is complete in itself—a 10-minute sound production covering one particular phase of arc welding in full detail.

Organized groups may borrow the films with no charge other than transportation costs; schools and industry may buy single reels at cost—$52 each—for use in training welders. Write Campus News, General Electric, Co., Schenectady, N. Y.

SH-H-H-H-H-H!

THE one announcer in the country who can give weather forecasts over the air is a mechanical man who broadcasts from a point 12 miles up in the stratosphere, where next week's weather is in the making.

This mechanical investigator, whose heart is an electron tube, works for the U. S. Weather Bureau. He weighs only a couple of pounds and looks like a large box camera.

As a small balloon takes him up, the robot broadcasts the atmospheric conditions he finds. Tuned in with a ground receiver, the radio signals tell the temperature, wind velocity, etc. The balloon bursts at the low pressure limit (about 60,000 feet above ground), and a parachute brings the radio sonde, as it is called, down to earth.

The mechanical weatherman carries a calling card with his return address on it in case he gets lost on the way back.

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I L L I N O I S

TECHNOGRAPH

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NOMOGRAPHS

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HE SPECIALIZES IN "BIG STUFF."
L. A. Kilgore has been designing electric generators, rectifiers, and motors ever since he joined Westinghouse . . . but his 40,000 h.p. Wright Field wind-tunnel motor tops them all. Kilgore received his E. E. at the University of Nebraska and his M.S. at the University of Pittsburgh.

The hurricane that shapes an eagle's wings.

THE LIGHTNING SPEED of the modern warplane has brought a lot of headaches to aircraft designers.

Wind-tunnels, the "proving grounds" of aviation, were satisfactory for studying the performance of the lighter, slower planes of yesterday. But they were not adequate for today's fighter planes . . . with top speeds of *over 400 miles per hour.*

To investigate the terrific forces at work at these high speeds, the U. S. Army demanded a wind-tunnel that would produce a tornado many times greater than Nature's wildest gale.

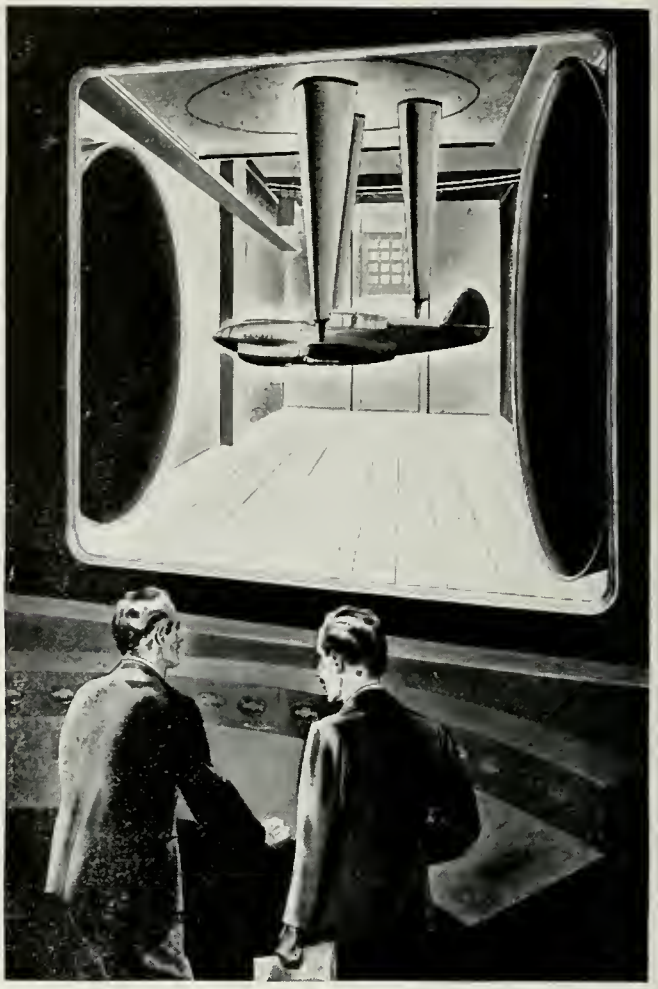
Army officials asked Westinghouse to take over the job of *building the electric motor* to drive the fans in this tunnel.

The two fans were to be truly colossal . . . 40 feet across, with a combined weight of nearly 150 tons. They were to be mounted on a 16-inch solid steel shaft, 120 feet long. Merely starting this great mass in motion, with minimum disturbance to the power system, was the toughest kind of engineering problem.

To complicate the problem further, a wide range of air speeds is required for wind-tunnel testing. And at each air speed the motor speed must be held constant, regardless of fluctuations in the electric power lines.

L. A. Kilgore . . . in collaboration with J. C. Fink . . . tackled the problem. In twelve months these Westinghouse engineers designed and supervised the construction and installation of a 40,000 hp wound-rotor induction motor . . . world's largest of its kind . . . an installation that met every Army requirement.

That 40,000 horse power motor . . . a direct result of Westinghouse "know how" . . . is now in service in the new $2,500,000 wind-tunnel at Wright Field. Large airplane models and actual-size motors, with whirling propellers, are tested and studied in its 400-mile-an-hour windstream.



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Kilgore and Fink have given vital aid to winning the war . . . for they have helped to make it possible for Army experts to learn many new facts about plane performance and plane design, facts of utmost importance in gaining and maintaining air supremacy over the Axis.

Today the need for engineers is very great. Of the 300 young engineering graduates who joined Westinghouse last spring, many are already showing great promise in engineering.

Westinghouse looks to the Class of '43 for its future scientists and engineers.

• • •

THE WESTINGHOUSE ENGINEER . . . a quarterly magazine brimful of interesting articles on electronic research and electrical engineering . . . keeps you posted on the latest scientific developments. Profusely illustrated. Subscription, only 50¢ a year. Address: Westinghouse Electric & Manufacturing Company, Department 6N-17, East Pittsburgh, Pennsylvania.

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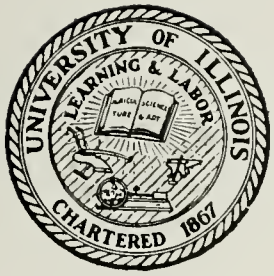
NOVEMBER ★ 1942



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Published Eight Times Yearly by the Students of the College of Engineering, University of Illinois

Published eight times during the year (October, November, December, January, February, March, April, and May) by The Illini Publishing Company. Entered as second class matter, October 30, 1921, at the post office of Urbana, Illinois. Office 213 Engineering Hall, Urbana, Illinois. Subscriptions, $1.00 per year. Single copy 20 cents.
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Frontispiece . . .

In the 20-below zero temperature of the refrigerated "igloo" of a Westinghouse laboratory, a circuit breaker is being prepared for a high-voltage test. *(Cut courtesy Westinghouse).*

★

Cover . . .

All-out production of war materials by American Industry. *(Cut courtesy General Electric).*

A SHORT COURSE
. . . *in Nomography*

By MR. S. H. PIERCE
Associate in G.E.D.

Through the ages man has endeavored to find methods for simplifying calculation of numerical equations so that speed and accuracy may be achieved. One notable forward step was Napier's discovery of logarithms that was published in 1614. By means of a table of logarithms, a thorough understanding of its use and accuracy in application to specific problems, one is able to shorten the time required to determine the answer to a mathematical equation.

Lieutenant Amèdèe Mannheim, a French artillery officer, found that he required a faster means of calculation in order to train his guns on a target with greater speed. He constructed one of the first slide rules that took advantage of the principles of logarithms but eliminated the necessity of adding logarithmic numbers to realize an answer. Of course his slide rule was not the "slip stick" of beauty and dexterity that we see on the hip of most every engineer today, but it was a modest beginning in the field of rapid calculation.

Eventually the alignment chart, or nomograph, was devised by Maurice d'Ocagne in 1899. His classical work on this subject was published in the book "Traitè de Nomographie." Briefly, a nomograph is an arrangement of scales, each representing a variable in an equation, that are spaced and graduated so that by laying a straight edge across them at known values the unknown quantity may be read directly. Such a chart can be used by persons who have had comparatively little training in mathematical problems and the results obtained are sufficiently accurate for most engineering work. There is no difficulty in determining the position of the decimal point as is the case with slide rule calculations and furthermore, the time saved by the use of nomographs is tremendous.

Many forms of alignment charts have been devised to represent the diversified types of equations that are encountered; also, several methods are used in their design. Since each variable in an equation is represented by a scale on the chart, it is necessary to have at least as many scales as there are variables in the equation. Also the arrangement of the functions of the variables has a bearing on the form of chart to be used. The illustration below, Figure 1, shows typical arrangements of scales for several type forms of equations. Where an equation has a product of functions it may be reduced to a sum of functions by taking logarithms of the equation. Such scales would be graduated logarithmically on the chart.

Two methods generally used in designing nomographs are the determinant and the geometrical method. The use of determinants is a delicate mathematical procedure and is used best by those who have had considerable experience with them. Excellent results are obtained by the novice with the geometrical method if he has an

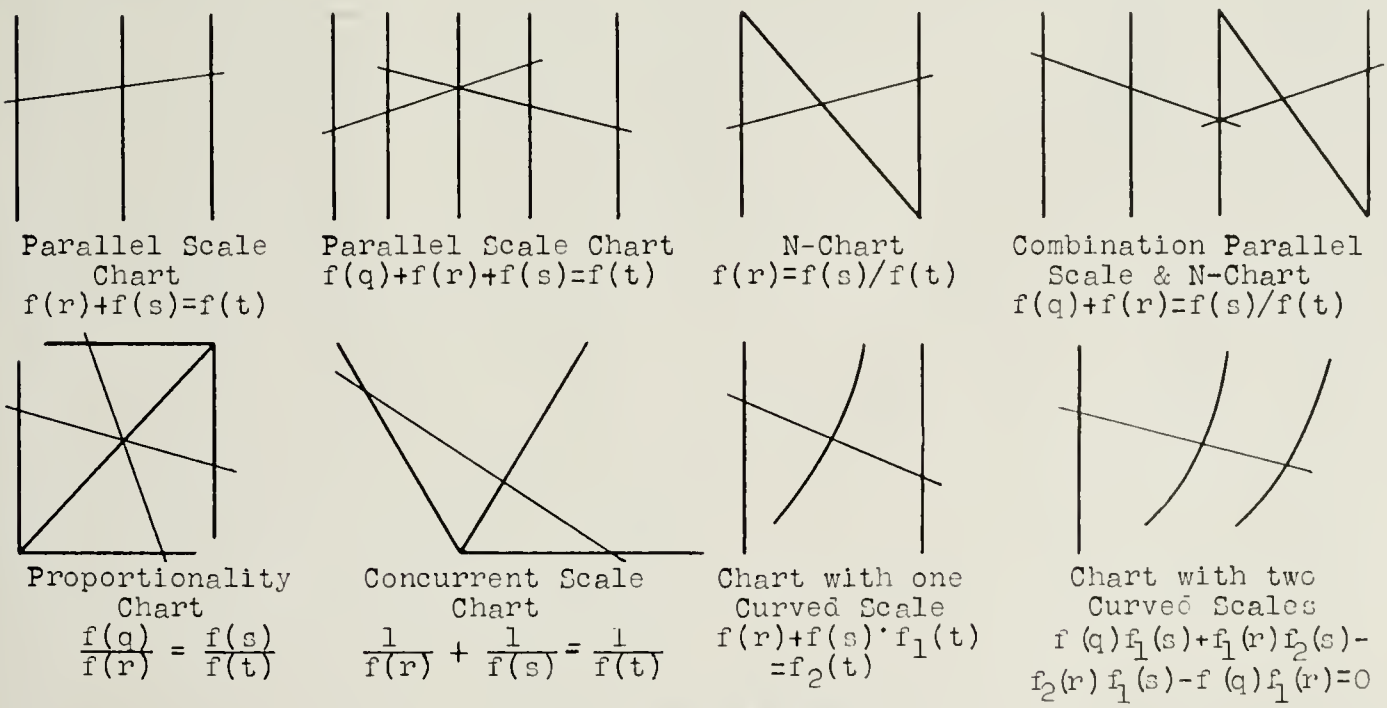

Fig. 1. Common Chart Forms

average knowledge of algebra, logarithms and geometry.

All parallel scale charts of three or more variables have as their basis the simple three variable parallel scale nomograph shown in Fig. 1. The type form of equation that this chart solves is $f(r) + f(s) = f(t)$ and the functions do not necessarily have to be of the same kind. The function of (t) is plotted on the middle scale and the other functions are plotted on the outside scales.

When designing a chart for this type of equation, the relative scale spacing and the method of graduating them, to give a proper solution, must be determined. The derivation of these relationships is short and will be given below.

The separate scales are called functional scales, because they indicate distances that are proportional to the values of the functions for the numbered values of the variable. In making a functional scale between certain definite limits, the values of the function are multiplied by a factor of proportionality. This factor is termed a functional modulus and is designated by the letter "m" with a subscript to denote the function to which it is assigned.

The meaning of a functional modulus may be made clear by an example such as the scales on a mechanical engineer's scale. The length of the full size scale is divided into twelve one inch units so that one inch on the scale represents one unit of measurement. On the $\frac{1}{4}'' = 1''$ scale there are forty-eight units and in this case one-fourth inch on the scale represents one of these units. The value, one-fourth inch per unit is termed the functional modulus for the scale.

Expressed in mathematical form: where L_X is the length of the scale, m_X is the functional modulus, $f(X_2)$ the upper limit of the function of the function to be plotted and $f(X_1)$ the lower limit of the function

$$L_X = m_X [f(X_2) - f(X_1)] \quad \cdots \quad (1)$$

If the lower limit of the function is zero, then

$$L_X = m_X f(X_2) \quad \cdots \quad (2)$$

Figure 2 shows the geometrical basis for the construction of a three variable parallel scale chart that solves an equation of the form $f(r) + f(s) = f(t)$.

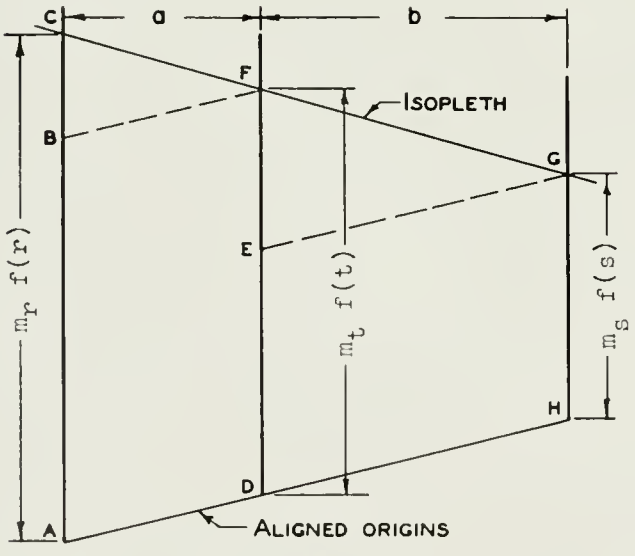

Fig. 2. Geometrical basis for construction of Parallel Scale Charts

It is assumed that A, D and H are zero values of the functions (r), (t) and (s) respectively and the isopleth is a line that intersects the three scales at values satisfying the given equation. BF and EG are drawn parallel to AH.

From the similar triangles BCF and EFG

$$\frac{BC}{a} = \frac{EF}{b}; \text{ or, } \frac{AC - DF}{a} = \frac{DF - GH}{b} \quad (3)$$

From the previous discussion, the lengths of the functional scale are

$$AC = m_r f(r),\ DF = m_t f(t) \text{ and } GH = m_s f(s)$$

Substituting these values in equation (3) and collecting terms

$$m_r f(r) + \frac{a}{b} m_s f(s) = m_t \left(1 + \frac{a}{b}\right) f(t) \quad \cdot \quad (4)$$

To reduce this equation to the type form $f(r) + f(s) = f(t)$, the coefficients of the three terms must be equal, or

$$m_r = \frac{a}{b} m_s = m_t \left(1 + \frac{a}{b}\right). \text{ If } m_r = \frac{a}{b} m_s, \text{ then}$$

$$\frac{m_r}{m_s} = \frac{a}{b} \quad \cdots \quad (5)$$

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This establishes the scale spacing a b in terms of the functional moduli of the two outside scales.

$$\text{If } m_r = m_t \left(1 + \frac{a}{b}\right), \text{ then } m_r = m_t \left(1 + \frac{m_r}{m_s}\right)$$

$$\text{or } m_t = \frac{m_r m_s}{m_r + m_s} \quad \cdots \quad (6)$$

which gives the relationship between the outside scale functional moduli and the functional modulus for the center scale. Equations (1), (5), and (6) are always used in designing any parallel scale chart and they should be learned thoroughly by the beginner.

The application of these equations in designing a simple chart will be given for the kinetic energy equation, $KE = WV^2/64.4$ with limits of the velocity V from 30 to 90 feet per second and the weight W from 10 to 100 pounds. The limits for KE are 140 to 12,600 foot-pounds as found by substituting the values of W and V in the equation.

Conversion of the equation into a sum of functions is accomplished by taking logarithms of the expression to obtain

$$\text{Log K.E.} = \text{Log W} + 2 \text{ Log V} - \text{Log } 64.4$$

The constant term Log 64.4 may be disregarded, as it will be taken care of automatically when the third scale is plotted. It is possible to choose functional moduli for two of the scales but the moduli for the third scale is determined from equation (6) above.

Equations for the lengths of the W and V scales are:

$$L_W = m_W[\text{Log } 100 - \text{Log } 10] = 1 \cdot m_W$$

$$L_V = m_V[2 \text{ Log } 90 - 2 \text{ Log } 30] = 0.954 m_V$$

If we choose $m_W = 10''$ per unit and m_V also $10''$ per unit, the lengths of the W and V scales will be $10''$ and $9.54''$ respectively. The ratio of a/b will be unity so that the middle scale will be placed exactly half way between the outside scales.

Calculation of the functional modulus for the center scale is determined from equation (6).

$$m_{KE} = \frac{m_W m_V}{m_W + m_V} = \frac{10 \times 10}{10 + 10} = 5 \text{ inches per unit}$$

This completes the calculations needed to construct

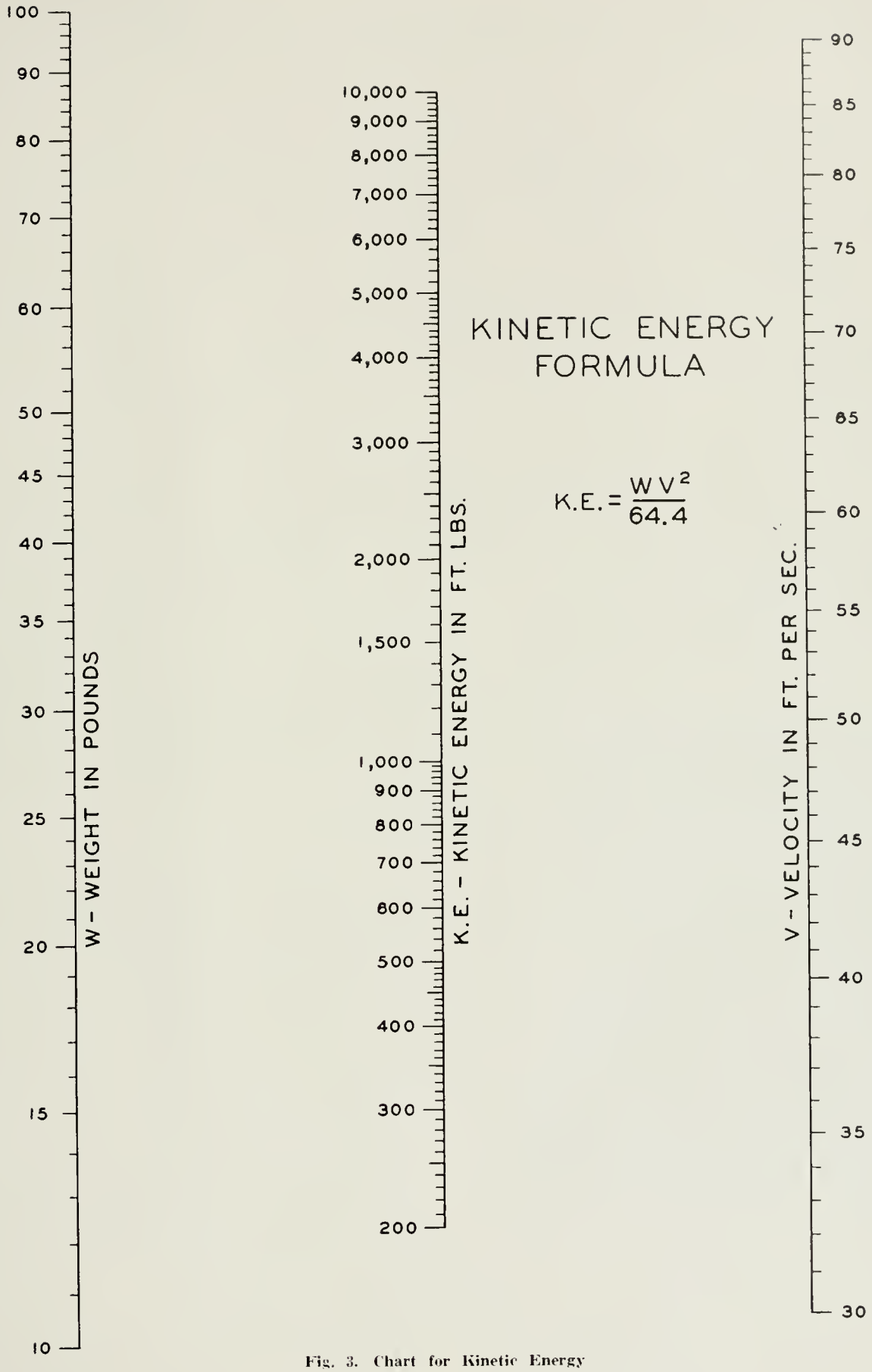


Fig. 3. Chart for Kinetic Energy

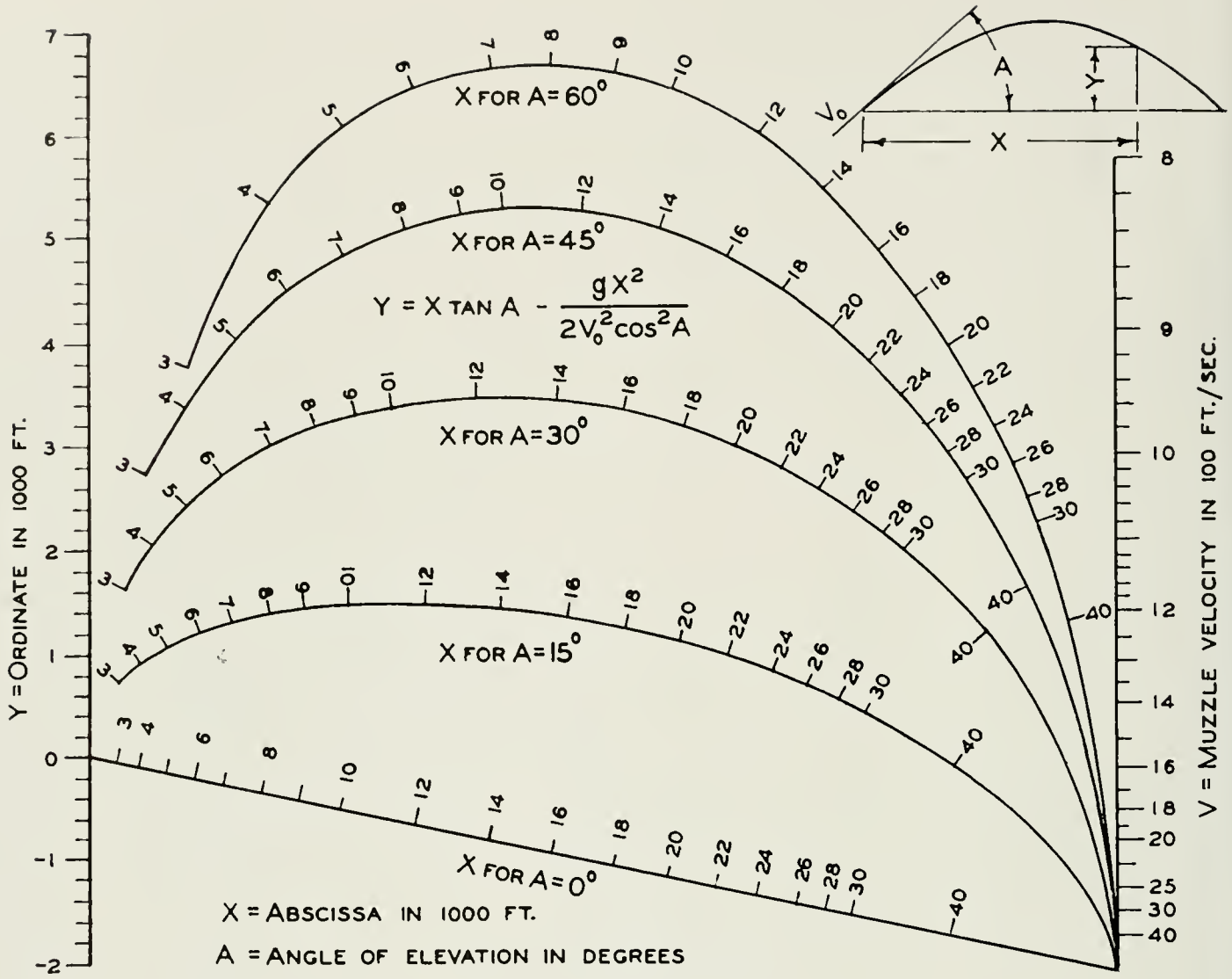


Fig. 4. Projectile Trajectory Chart

the nomograph. To plot values of W = 10, 20, etc. to 100 on the W scale, multiply the logarithms of these numbers by the functional modulus $m_W = 10$ and mark off these distances on the left hand scale. The V scale is plotted by multiplying values of the function 2 Log V, when V equals 30, 40, etc., by the functional modulus $m_V = 10$ and marking these distances on the right hand scale.

If a line is drawn connecting the values of W = 10 and V = 30 its intersection with the middle scale is the point where KE = 140. This establishes a starting point for graduating the K.E. scale logarithmically using a functional modulus of 5″ per unit. After marking the major graduations it is best to check the chart to be sure that it solves the equation for several positions of the isopleth. Further subdivisions can be added to allow accurate reading of intermediate values. Figure 3 shows the completed chart for this equation.

The equation for projectile trajectory contains four variables but for convenience is reduced to one of three variables by assuming values for the angle "A". Since the variable X appears in two different functions, the scales for X are curved. It is interesting to note that in most cases two values of X are obtained when using an isopleth across the chart. An examination of the path of a projectile, as shown in the sketch in the upper corner of Figure 4, shows that this is to be expected.

In recent years the various technical journals have been publishing charts for use in engineering fields. Civil engineers would be interested in the charts designed by Lieutenant James R. Griffith, USNR, formerly professor of structural engineering at Oregon State College. These have been published monthly in Western Construction News since 1939. Electrical Engineering for December 1940 contains an article by Guido E. Farrara dealing with charts for electrical engineers. A large number of charts are found in mechanical engineering magazines because they are especially useful for formulas that are met in mechanical design.

From this brief description of the construction and use of alignment charts, it is evident that they are tools of great importance in the engineering world.

Note: Figures 1, 2 and 4 are reproduced from *Graphic Aids in Engineering Computations* with permission of the authors.

Professor Babbitt: Why are so many Chinese named Wing?

Homer Wong: Because fifty million Chinese can't be Wong!

THE BERMAN LOCATOR

By DONALD HALLBERG, G.E. '46

There was but one instrument of its kind in the world that could immediately locate bullets, metal fragments, and shrapnel which were lodged in the human body. This instrument was the Berman Locator. On the seventh day of December, 1941, by an act of fate it was placed in a Honolulu hospital. During the day which we remember so well, it helped a small number of doctors to treat 960 casualties! Such is the dramatic opening to the story of an instrument which was developed to fill a long-felt want in the field of surgical aid.

The Berman Locator was designed to aid surgeons in locating metal fragments which are lodged in the body. Despite the development of X-Ray localization devices by means of which the position of a foreign body may be indicated with high precision, the fact remains that at the operation, when an incision is made, the disturbances to the tissue by knife, forceps, and retractors move the foreign body from its original position, and the surgeon is left entirely on his own. Some may say: "Why not use a fluoroscope?" There are many difficulties connected with the use of the fluoroscope during an operation. First, the surgeons cannot readily protect his hands with lead gloves while operating. Then, the darkened room may endanger sterilization, and, as a number of attempts are usually necessary, much valuable time is lost. Because of these, and other difficulties, the fluoroscope is not entirely satisfactory. These facts make foreign body surgery extraordinary difficult, and surgeons of unquestioned skill are at times forced to give up in failure.

The Berman Locator, which is operated on the principle of electro-magnetic induction, safely, silently, gives the surgeon instantaneous and continuous localization of metallic foreign bodies both from the exterior, prior to operation, or within the incision during an operation. The locator, which is a light instrument, weighing only 20 pounds, has none of the disadvantages of the X-ray, when used at the operating table. It is quick, reliable, highly sensitive, small, easily portable, and has no injurious radiation or high voltages, is readily sterilizeable, and is used under full illumination of the operating field.

In quite a number of foreign body operations, this instrument has been used without a single failure, and in some cases without the aid of X-ray photographs. It must be emphasized, however, that the locator is by no means intended to take the place of or render superfluous, the usual X-ray localization prior to operation. In some simple cases, such as a small fragment in the hand, where the history is fully known, the locator itself may be quite sufficient. In general, though, and particularly where there may be multiple fragments, X-ray photographs, if at all available, should be obtained first.

Essentially, Model BL3 is a modified form of vacuum tube voltmeter comprising a probe containing a search coil and its associated circuit, connected to a high gain amplifier whose output feeds into a meter circuit. The probe and meter circuits are so balanced that when there is no metal within the effective field of the probe, the meter reading is approximately zero. When metal is introduced within the effective field of the probe, the original inductive balance is disturbed, and the meter needle rises higher and higher until a maximum indication is reached where the probe is closest to the body.

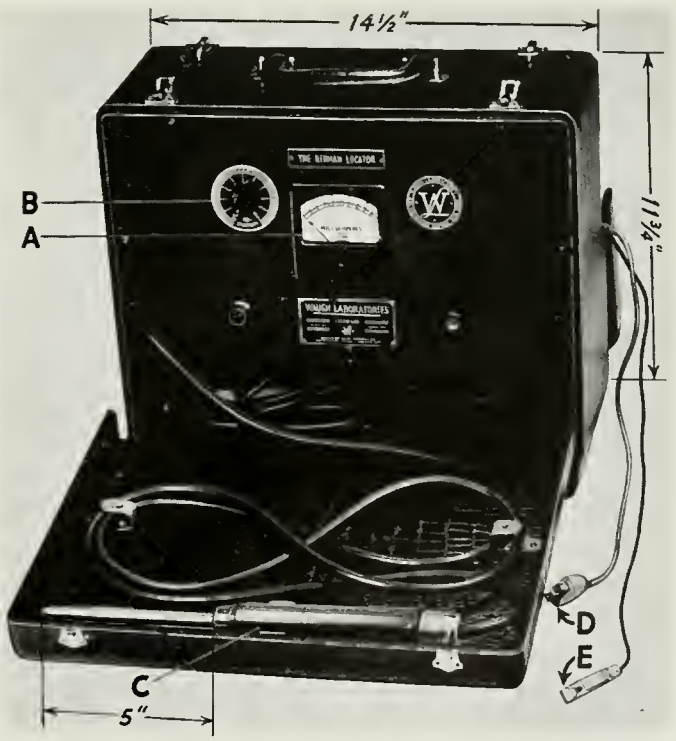
Each instrument is provided with a 20-foot ground lead which terminates in a spring clip. This clip should be attached to a good ground, such as a water pipe, an electrical conduit, or other grounded metallic conductor which has been thoroughly cleaned of rust, paint, dirt, etc., so that a good electrical contact is assured. This is necessary for two reasons: the elimination of body capacity, which may affect the meter indications, and the removal of static charges which may otherwise cause tiny sparks upon contact with the probe.

On the instrument panel there is but one operating control, located near the upper left-hand corner, marked "Sensitivity." This control is combined with the 115-volt A.C. power switch, and is similar in its action to the ordinary volume control of a radio receiver. The low senstivitiy is obtained near the "off" position of the control and the maximum sensitivity is obtained at the extreme right-hand end of the dial.

The probe handle has a control sleeve can be rotated to the right or left, and can also be slid up or down. This sleeve moves two inductive elements whose correct adjustments are essential for obtaining maximum efficiency in the operation of the locator. For a better understanding of these controls, the following information will be helpful.

The detecting circuit associated with the probe consists

(Continued on page 18)

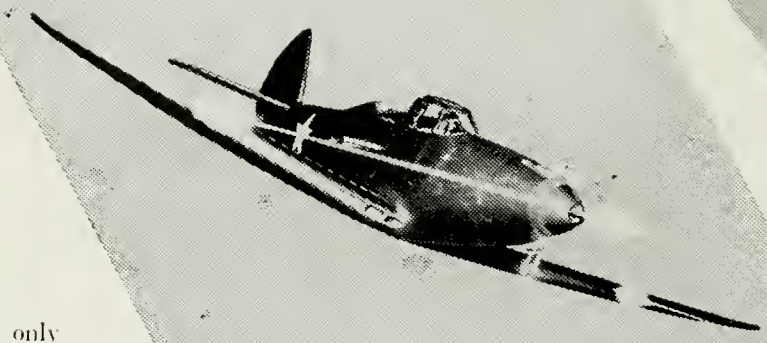


—Courtesy Waugh Laboratories

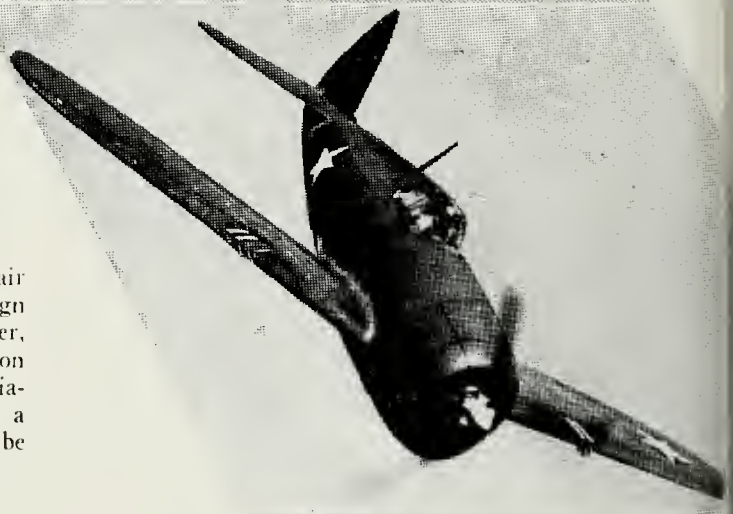
THE BERMAN LOCATOR

A. Indicating Meter
B. Switch and Sensitivity Control
C. Probe
D. Power Plug
E. Grounding Connection

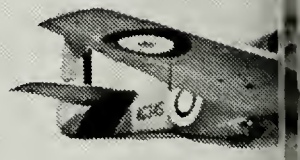
The F4F Wildcat is the Navy's standard fighter. Its short, barrel-like fuselage and stubby wings make it ideal for use from the cramped space of aircraft carrier decks. Powered with a radial air-cooled engine, it mounts heavy calibre guns in the wings.



The Army's P-39 Aircobra is the world's only single-engine fighter armed with a 37-mm. cannon. In addition, it is armed with heavy and light machine guns. Designed to operate out of small fields, as a destroyer of heavily armored bombers and as an attacker of armored ground forces, it has been in successful combat as high as 30,000 feet.

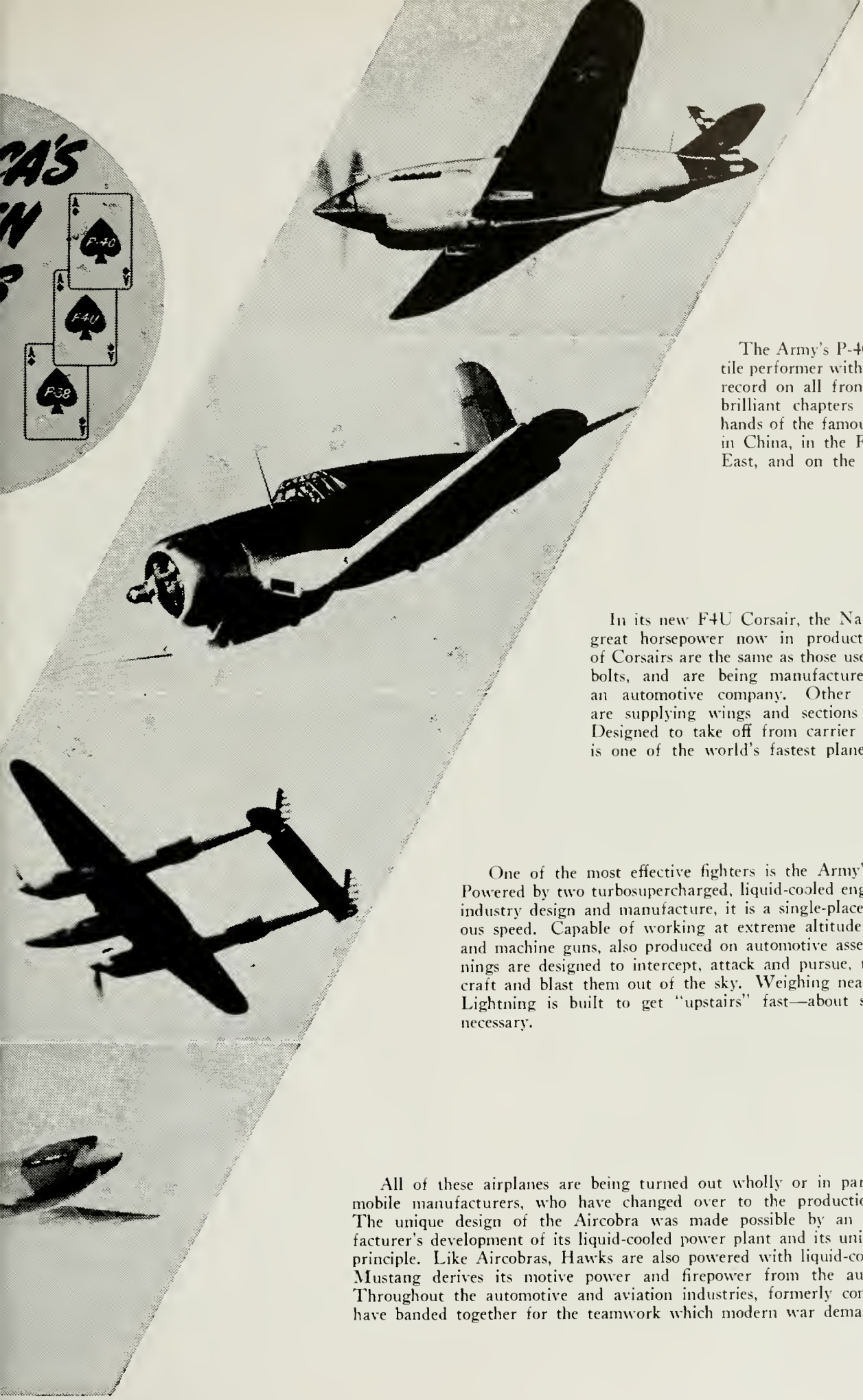


The Army Air Force's newest threat to an axis' bid for air supremacy is the huge and powerful P-47 Thunderbolt. No foreign fighter in service has an engine as powerful as its 2,000 h.p., 18-cylinder, air-cooled, turbosupercharged, radial motor, that drives this seven-ton devastator. These power plants, the fruit of years of American aviation industry pioneering, are now being produced in quantity by a former motor car manufacturer. The Thunderbolt may prove to be one of the most sensational fighters of the war.



The Army's P-51 Mustang fighters got their baptism of fire in the hands of the R.A.F. Their speed, maneuverability and firepower made them important factors in the air war before Pearl Harbor. Rated among the best by the British, it has been used with devastating effect in operations over northern France. The Mustang was designed primarily for ground force cooperation. It performed brilliantly in the Dieppe raid. Like most Army fighters, the Mustang derives its motive power and firepower from the automotive industry.

(Courtesy Auto



The Army's P-40 Hawk is a versatile performer with an imposing battle record on all fronts. It has written brilliant chapters of history in the hands of the famous "Flying Tigers" in China, in the Far East, the Near East, and on the Russian front.

In its new F4U Corsair, the Navy has a fighter of great horsepower now in production. The engines of Corsairs are the same as those used in the Thunderbolts, and are being manufactured in quantity by an automotive company. Other automotive plants are supplying wings and sections of the airframes. Designed to take off from carrier decks, the Corsair is one of the world's fastest planes.

One of the most effective fighters is the Army's P-38 Lightning. Powered by two turbosupercharged, liquid-cooled engines of automotive industry design and manufacture, it is a single-place craft of tremendous speed. Capable of working at extreme altitude, it carries cannon and machine guns, also produced on automotive assembly lines. Lightnings are designed to intercept, attack and pursue, to dive into enemy craft and blast them out of the sky. Weighing nearly seven tons, the Lightning is built to get "upstairs" fast—about seven miles up, if necessary.

All of these airplanes are being turned out wholly or in part by former automobile manufacturers, who have changed over to the production of war planes. The unique design of the Aircobra was made possible by an automotive manufacturer's development of its liquid-cooled power plant and its unique power-transfer principle. Like Aircobras, Hawks are also powered with liquid-cooled engines. The Mustang derives its motive power and firepower from the automotive industry. Throughout the automotive and aviation industries, formerly competing companies, have banded together for the teamwork which modern war demands of fighters.

· *Production)*

NAMES *in the* NEWS

By WILLIAM R. SCHMITZ, Ch. E. '45
and
LEE A. SULLIVAN, M. E. '46

PAUL SALERNO

Paul Salerno is chairman of A.S.M.E., member of Pi Tau Sigma, Tau Beta Pi, and is the writer of "Technocracked" appearing elsewhere in this issue. Paul spent his first two years at Wright Junior College in Chicago. After that he stayed out of school for two years and worked. It was then that he found out that he wanted to be a mechanical engineer.

Since transferring to Illinois, Paul has been doing very well. He has a fine 4.4 scholastic average and is working on a research project in the T.A.M. department. He is working on water ejector pumps and is writing a thesis on it. Subjects relating to hydraulics have been especially interesting to Paul. The idea of being a business executive appeals very much to Paul and he would like to work himself eventually to that position.

Paul has several hobbies including photography, bowling, and tennis. Paul does some dating, but saves most of it until he goes home to Oak Park. He says the worst trouble down here is that there aren't enough coeds, but what there are, aren't too bad.

Like all the other outstanding engineers, Paul thinks that all too many engineers stay too close to their books. He says only half of a college education is gained in the classroom. The other half comes from working in activities and meeting people. That is one reason he likes being chairman of A.S.M.E., he gets to meet all the guest speakers.

PAUL

☆

STERLING SNYDER

One of the most likeable fellows in the Engineering school is Sterling Snyder. He is president of A.S.C.E. this semester and is doing a good job of it. The biggest job, according to Sterling, is to keep the various committees coordinated and functioning properly. It takes a lot of time, but the enjoyment he receives makes it worth while.

STERLING

Coming from Memphis, Tenn., Sterling uses his southern accent and good looks to the best advantage in dating the coeds around the campus. In the words of a civil engineer, he says, "My dating is statically indeterminate." Sterling believes the girls at Illinois are a lot more industrious than the girls down South, but they also have slightly less beauty.

Sterling came to Illinois partly because his father, who is also a C.E., was much impressed by the work turned out by Illinois engineers. Quoting Sterling, "One hardly realizes how outstanding men at Illinois are until he works for practicing engineers who constantly refer to methods of analysis of engineering problems developed by men at Illinois."

Sports, especially softball and tennis, appeal very much to Sterling. He also has one other favorite pastime, and that is eating—eating fried chicken. He enjoys hearing classical music too.

☆

JIM MEEK

Activity man among the civil engineers is Jim Meek. Jim is business manager of the Illio, President of Phi Delta Theta, member of Chi Epsilon, A.S.C.E., Phi Eta Sigma, Skull and Crescent, Sachem, Ma-Wan-Da, T.N.T., Scabbard and Blade, and is a Cadet Captain in the Engineers Corps.

Hailing from Carrolton, Illinois, Jim has done very well since he came to Illinois. He has a nifty 4.25 scholastic average and is teaching G.E.D. 1 this semester. He passes this little bit of advice on to the freshmen, "Study hard and make the most of every available opportunity."

JIM

Jim is quite a sportsman. He likes to hunt, fiish, and participate in athletics of all kinds, especially football, basketball, track, wrestling, volleyball, tennis, and handball. He also takes in a good number of social affairs. His attentions have all been directed to one girl since he has his pin on the woman's editor of the Illio.

A business manager of the Illio, Jim is kept pretty busy. It is his job to take charge of all underclassmen working on the Illio business staff. He is also responsible for all sales, bills, and anything connected with the financial end of the Illio.

Jim first got his taste of engineering from his uncle, and ever since he has liked that kind of work. This last year he worked on a project determining the mixing temperature on the setting of concrete.

ART POPE

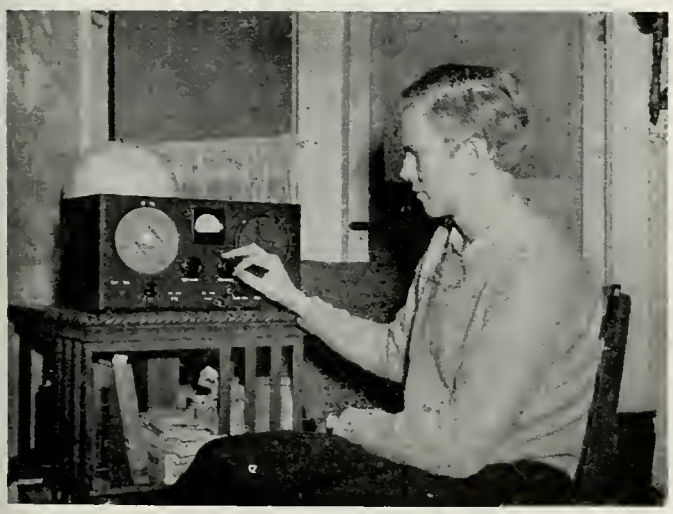
Art is a member of Phi Eta Sigma, Scabbard and Blade, T.N.T., Pershing Rifles, secretary-treasurer of Military Council, Cadet Major of the Engineers, senior manager of the Theater Guild, and is on the military ball committee.

As manager of the Theater Guild, Art has charge of everything that takes place, except the actual production. It is his job to advertise the show and see that the house is full the night of the performance. This takes most of his spare time, but Art still finds time to do some reading and fencing. He also likes boat riding and horseback riding.

Art was president of his sophomore class and likes to work in politics. He has especially enjoyed the contacts he has made with people, and the new ideas he has received from them.

His pet peeve is women who wear too much make-up. So girls, you had better beware if you hope to interest Art. Art says that he hasn't done much dating lately, but has been going with a girl at Evanston. His home town is Lake Forest, Illinois.

Art thinks there ought to be some way in which students and faculty members could get to know each other better. One other suggestion that Art has is that Illinois needs a lake. He particularly admires Wisconsin's lake, but on the whole he likes Illinois' campus better than any he has seen.



ART

JACK BOGGS

Jack Boggs is a mechanical engineer and came to Illinois from the deep South. Sarasota, Florida claims this fair-haired son and is justly proud of him. There are several reasons why Jack came all the way to Illinois, but the main reason is that he wanted to go to a good engineering school, naturally it was Illinois.

JACK

Jack has been an active man since he arrived on Illinois campus. He is senior manager of Intramural athletics, president of Alpha Tau Omega, member of Scabbard and Blade, T.N.T., Sachem- Ma-Wan-Da, and is a Cadet 1st Lieutenant in the Engineers Corps. He has also worked on The Daily Illini.

It may be just a coincidence, but Jack's home-town girl is also going to school at Illinois. He has been going with her for five years and she now has his pin. He says that he likes to take in all dances and big social events possible.

Jack thinks that the engineers here at Illinois don't get out enough and enjoy themselves. Everyone should be in an activity, and still keep up his studying. Jack likes popular music and rates Glenn Miller as his favorite band. Jack, himself, used to play a saxophone.

From his early youth, Jack has worked with his father, who is a civil engineer. He says that he finally would like to get into aeronautical engineering. Jack has done pretty well since coming to Illinois as shown by his good 4.1 scholastic average.

Our Societies . . .

By BYRON M. ROBINSON, M. E. '44

TAU BETA PI

On Wednesday night, November 18, Tau Beta Pi will have a meeting for all the pledges. At this time pledges will sign into the chapter record, and will receive their pledge rules. Tau Beta Pi will hold its formal initiation and initiation banquet on November 28 at 5:45 o'clock followed by a dance at 9 o'clock. This will be held in the Union Building. All actives, and especially faculty members of Tau Beta Pi, are invited to attend not only the banquet but also the dance. Further details, as well as a reservation blank, have been mailed to all members. Jay Hinchcliffe, E. E. '43 is handling the banquet arrangements; and Bob Kallal, Ch. '43 and George Asselin, Ch. '43 are taking care of the dance.

A. S. M. E.

At the fourth meeting of the Student Branch of the A.S.M.E., held on November 13, papers were presented by four senior mechanical engineering students. The titles of the papers and the men who presented them are as follows:

"Effect of Hot Quenching on the Toughness of High Speed Steel" by Gus Greanias.

"Water Ejector Pumps" by Paul Salerno.

"The effect of Range of Stress on the Fatigue Strength of a Phenolic Plastic" by W. A. Lindahl.

"Creep Test of a Phenolic Plastic" by Otto Hintz.

Members of the Peoria section of the A.S.M.E. were present at the meeting as guests of the student chapter.

A. I. E. E.

"Electric Power and the War Effort" was the interesting and very up to the minute subject discussed at the AIEE meeting of November 4th. The meeting held in conjunction with the Urbana section of the AIEE was addressed by Mr. T. G. LeClair who proved himself to be a most capable and enlightening speaker as well as possessing a very amiable and friendly attitude toward questions asked of him after the session. It was encouraging to see a goodly number of engineering students from all classes present and from all expressions, it was very well received.

"Our student AIEE section is the only organization on Campus which represents the Electrical Student and unites both student and faculty in a united effort of mutual benefit. The AIEE needs you and even more, you need us. We certainly welcome you at any and all of our sessions," says Vern Rydbeck, chairman.

A. S. C. E.

At the second meeting of the A.S.C.E., held October 15, Ensign Burnett of the U. S. Naval Diesel School spoke on "The Part the Civil Engineer Plays in the Navy." At the October 29 meeting, Mr. Paul Kent of the General Paving Company presented color movies and spoke of the building of Illinois highway 45 between Urbana and Rantoul. On November 13 and 14, the Illinois chapter was host to the Annual Midwest Conference of Student Chapters of A.S.C.E.

S. B. A. C. S.

At the third meeting of the Student Branch of the American Ceramic Society, held November 3, Mr. C. S. Pierce, Director of the Porcelain Enamel Institute, Washington D. C., spoke on "How the Enameling Industry is Meeting the War Needs." He gave many interesting insights into the war work of that industry, and he stated that the future of the enameling industry looks bright. With the announcement that plans for the pig roast to be held December 10 were well under way, the meeting was adjourned to enjoy refreshments of cider and doughnuts.

CHI EPSILON

Senior civil engineers who will be initiated into Chi Epsilon this semester are Bill Hickman, Erwin Mueller, Erasmo Mendez, Bob Randall, and Lowell Lambert.

The incoming juniors are Howard Eichstadt, Sidney Epstein, Eugene Estes, Harold Hecker, Sheldon Leavitt, Bob Mosher, Carl Mueller, Harold Schwellenstattl, Arthur Skale, George Thomson, and Robert Tillman.

PI TAU SIGMA

A meeting entertaining prospective members was held on October 14 at which time Prof. O. A. Leutwiler, one of the charter members, gave a talk on the history and purposes of Pi Tau Sigma. From the group eligible, seventeen were selected and pledged on October 22. They were: H. H. Aiken, C. C. Arnold, K. N. Drager, G. G. Greanias, J. W. Huff, P. Kohler, R. E. Kraft, B. J. Lattyak, J. J. Luza, R. G. Moldt, D. E. Munie, W. J. North, B. W. Porter, C. J. Roach, R. G. Settle, V. K. Viitanen, and W. J. Worley.

At the meeting on November 4, Elmore Mays, President, was elected delegate to the Pi Tau Sigma National Convention which was held in Minneapolis, Minnesota on November 12, 13, and 14. He reported that the convention was both beneficial and enjoyable.

KERAMOS

Keramos began its activities of the year with a pledge smoker at the Illini Union Building on October 28. Tuesday, November 3, eight "neophytes" began their period, which ended with an informal initiation and a "feed" on November 12. Sunday evening, November 15, the following men were formally initiated into Keramos: F. A. Peterson, research department on Enamel Standards; C. R. Filipi, instructor in Ceramic Engineering; F. P. Shonkwiler and Ray Davies, seniors; W. J. Prentice, M. Klimboff, J. D. Peterson, and J. M. Durrant, juniors.

SIGMA TAU

Sigma Tau had a smoker for rushees at the T.K.E. fraternity, on October 22, featuring a quiz program conducted by Bill Lindahl, G.E. '43. Cider and doughnuts were served at the end of the meeting to relieve the mental strain. Tentative arrangements have been made for an initiation banquet at the end of November.

(Continued on page 22)

Before you call Long Distance, please ask yourself:

1. *Is it really necessary?* 2. *Will it interfere with war calls?*

TELEPHONE lines—especially Long Distance circuits—are crowded as never before, these war days. Materials to build new lines—copper, rubber, nickel—are needed for the shooting war. So we must get the most out of present facilities.

You can help us keep the wires clear for vital war calls if you will do these two things: (1) Don't call Long Distance unless it's urgent; (2) Call by number if possible and please be brief. Thank you!

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The Johnson Semi-Automatic Military Rifle, illustrated by courtesy of Johnson Automatics, Inc.

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BERMAN LOCATOR *(Cont. from page 11)*

of carefully balanced inductive elements, one of which is in the probe tip. In this balanced condition, there is no input from the detecting circuit into the meter circuit. When a piece of metal approaches the probe sufficiently to be within the effective range of its electro-magnetic field, the probe tip element suffers an inductance which raises or lowers its voltage or produces a shift in its phase with respect to the balance of the circuit. When any of these effects take place, the original balance is upset, and the meter needle moves toward the high end of the scale.

Magnetic metals such as iron and steel affect the circuit by virtue of their high magnetic permeability increasing the inductance and raising the voltage of the probe tip element, with practically no phase shift. Magnetic metals are detectable in the order of their magnetic permeability.

Non-magnetic metals such as silver, copper, aluminum, magnesium, lead, platinum, which affect the detecting circuit in a different manner, have eddy currents generated in them through the action of the alternating electro-magnetic surrounding the probe. These eddy currents produce a local magnetic field which reacts with the probe tip element, lowering its voltage somewhat and causing a relatively large phase shift. These non-magnetic metals are detectable in the order of their electrical conductivity; silver, copper, and aluminum being the most easily detected, while the poorer conductors such as lead, platinum, etc. have a correspondingly lower order of detectability.

Thus, the two general classes of metals, the magnetic and the non-magnetic, are detected through entirely different and somewhat opposed action of the circuits, the magnetic metals being detected largely by voltage change, and the non-magnetic metals, mainly by phase shift. This requires a slight readjustment of the probe handle control sleeve when going from magnetic to non-magnetic metal detection if maximum sensitivity of the instrument is to be realized.

The necessary circuit adjustment for maximum efficiency of detection is conveniently made with a control sleeve on the probe handle. This control sleeve by its movement varies the inductance and shifts the phase of the probe circuits. Sliding the control sleeve up and down varies the inductance, and, therefore, the voltage of the probe circuit. Rotating the control sleeve to the right or to the left shifts the phase of these circuits. This is accomplished without any sliding or other electrical contacts, but by purely inductive means.

In the circuit alignment of the instrument at the factory, the probe circuits are accurately balanced for both voltage and phase. But because the sensitivity of the probe is considerably higher at a slight unbalance than at the point of absolute balance, the meter needle is depressed electrically, below the scale zero, so that in the actual use of the instrument a definitely predetermined amount of unbalance is imposed upon the circuit in order to bring the needle up within the meter scale. This is what the operator accomplished with the handle control when he adjusts the instrument to the zero of the meter scale.

Since by "balance" is meant the point at which there is no input into the meter circuit, a condition approaching balance is indicated by the meter needle moving in a downward direction toward the zero of the meter scale. Since there are two different conditions for which a balance is obtainable, namely, voltage and phase, and since the two are very nearly indepedent of each other, a balance may be obtained for either one while the other is unbalanced. For example, if a phase balance is desired, the control sleeve is rotated in the direction which causes the meter needle to move downward toward zero, until some point is reached at which the needle reverses its direction, and moves off toward the high end of the scale. The point at which the needle reverses its direction is the Phase Balance point and may occur at any point on the meter scale, depending upon the degree of voltage balance at the time. Exactly the same is true of a voltage balance. The lowest position of the needle in the direction toward the zero that is possible to obtain when the control sleeve is slid up and down is the voltage balance point, and this may occur at any point on the meter scale depending upon the degree of phase unbalance at the time. Due to fact that the instrument has a depressed zero, an absolute balance (simultaneous voltage and phase balance) would cause the meter needle to go below the zero of the meter scale; so that in practical use of the instrument only one balance, either voltage or phase, is obtained while the other is unbalanced sufficiently to bring the needle within the meter scale.

It is the hope of Sam Berman that his locator can be used on the field of battle to help save the lives of many more wounded soldiers.

Our Christmas Wish

is that all you good U. of I. engineering

STUDENTS

will come to

NORMAN-ANDERSON

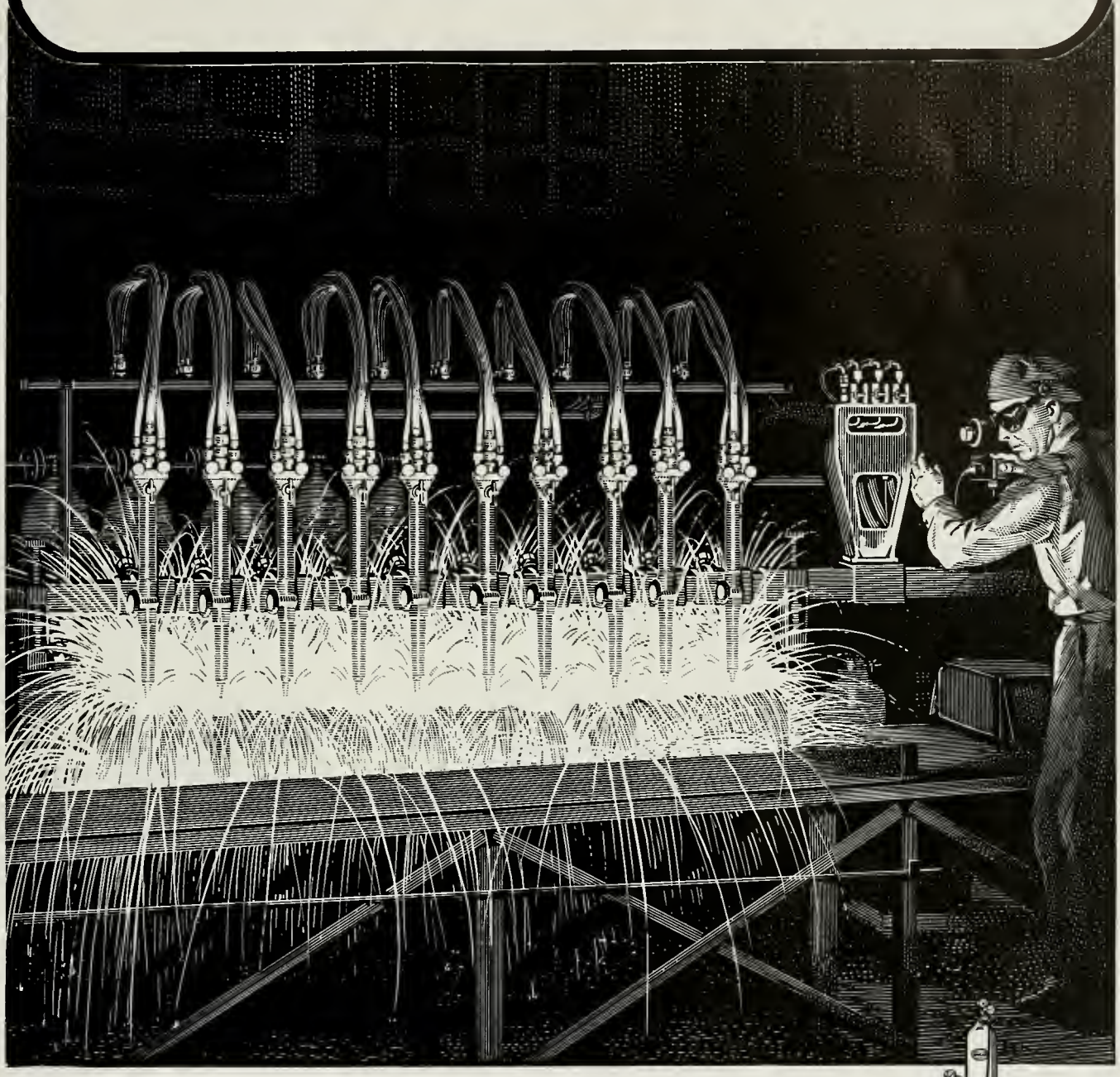
Jewelers

Green Street — On the Campus

FOR THE FINEST IN XMAS GIFTS

FOR HER — FOR HIM

A WEEK'S WORK EVERY DAY



TUBULAR headers now race off the production line at Combustion Engineering Company's Chattanooga, Tenn. plant at the unprecedented rate of 100 a day — with the aid of this Airco 10 cutting torch Oxygraph. Compared to the 19 a day formerly produced, it's practically a week's work every day. This Airco oxyacetylene cutting machine is making metal-working history — never before was such an elabarate multiple torch arrangement deemed practicable. Yet, as perfected by Airco, every beneficial feature of flame cutting is retained. Steel is accurately cut to the desired shape with amazing speed. And there is no time out for sharpening or regrinding.

New, faster, better ways of producing more planes, ships, tanks, guns and machines are made passible by the efficient and proper application of the oxyacetylene flame.

Ta better acquaint you with the many things that this modern productian tool does better we have published "Airco in the News", a pictorial review in boak farm. Write for a copy.

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TECHNOCRACKED . . .

By PAUL SALERNO, M. E. '43

PORTRAIT OF AN ENGINEER

A peculiar breed . . . the engineer
Not even a date can interfere
With his ambition
To win recognition.
Forever will he persevere.

Handbook open . . . slipstick working
Never, never, his duty shirking
Attempts acrobatics
With laws of mathematics
Somewhere near, the answer's lurking

Far into the night does the oil burn
Study and cram and try to learn
The rules of mechanics
And thermodynamics.
All else is of little concern.

You'll agree his plight's distressing
In fact this tale is quite depressing
To be a right guy.
Any change would be a blessing.

* * * * *

Coed to roommate: "I don't care much for that engineer you have been dating lately. He whistles dirty songs."

* * * * *

Instructor: Mr. Johnson, what is an octogenarian?
Johnson: I don't know, but it must take a long time to become one. They're all real old people.

* * * * *

In case any of you boys have been feeling pretty sharp lately, I wish you would try your hand at some of these.

1. Is it legal for a man to marry his widow's sister?

2. If three cats can kill three rats in three minutes, how long will it take 100 cats to kill 100 rats?

3. If a farmer has 3¾ haystacks in one corner of a field, 4⅓ haystacks in another corner and 2⅖ haystacks in a third corner, how many haystacks will he have if he puts them all together.

4. A big Indian and a little Indian are walking along a street. The little Indian is the son of the big Indian but the big Indian is not the father of the little Indian. What is the relationship?

5. A steel ladder hangs over the side of a ship. The rungs are a foot apart and the lowest rung just touches the water surface. The tide begins to rise at the rate of four inches per hour. How long will it take the water to reach the third rung from the bottom?

6. I have two common U. S. coins in my pocket. They total sixty cents and one is not a dime. What are the coins?

ANSWERS:

1. A dead man can't marry anyone.

2. Three minutes

3. One big haystack.

4. The big Indian is the mother of the little Indian.

5. The water level will never rise above the lowest rung because the ship rises with the tide. Stupid, aren't you?

6. A half-dollar and a dime. One coin is a dime and the other isn't.

* * * * *

First student: I feel like telling that professor off again.
Second: Waddaya mean, "again."
First: I felt like it yesterday, too.

* * * * *

A college boy wrote the following letter home.
Dear folk$:

Gue$$ what I need mo$t. That'$ right. $end $ome $oon. Be$t wihe,

Your $on,
Joe.

His father answered:
Dear Joe:

NOthing ever happens here. NOt a thing. Write aNOther NOte soon. NOw I must say goodbye.

Love,
Dad.

* * * * *

FAMOUS LAST WORDS

Here's hoping you all have a very enjoyable Thanksgiving vacation.

★ Buy U. S. Defense Bonds and Stamps ★

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933.

Of The Illinois Technograph published eight times a year (Oct., Nov., Dec., Jan., Feb., Mar., Apr., and May) at Urbana, Illinois for October, 1942.

State of Illinois } ss.
County of Champaign }

Before me, a notary public in and for the State and County aforesaid, personally appeared Dean E. Madden, who, having been duly sworn according to law, deposes and says that he is the business manager of The Illinois Technograph and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management and the circulation, etc., of the aforesaid publication, for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations.

That the names and addresses of the publisher, editor, and business manager are: Publisher, Illini Publishing Company, University Station, Urbana, Illinois:

Editor, L. Byron Welsh, Champaign, Illinois
Business Manager, Dean E. Madden, Champaign, Illinois.

That the owner is the Illini Publishing Company, a non-commercial corporation, whose directors are A. R. Knight, Fred H. Turner, C. A. Moyer, and Mrs. Ralph B. Clark of Urbana, Illinois, and Fred Siebert, Joseph Rarick, Margie Bitzer and Christ D. Kacalieff of Champaign, Illinois.

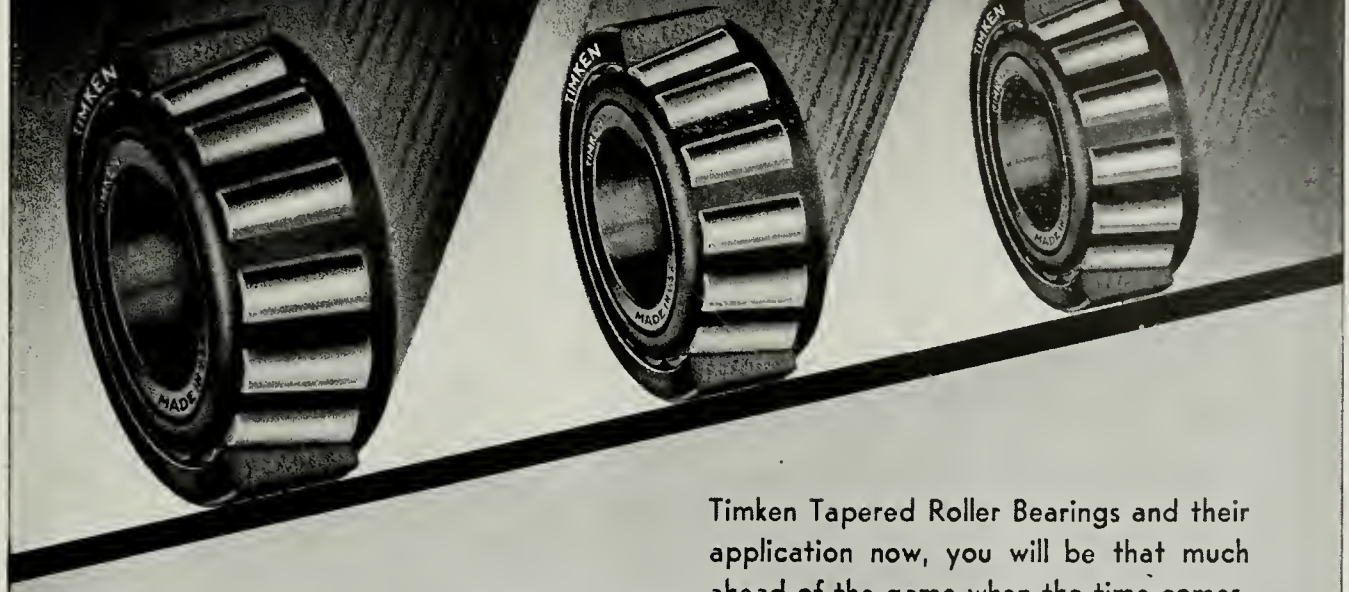
DEAN E. MADDEN, Business Manager.

Sworn to and subscribed before me this 26th day of October, 1942.
(SEAL)

ALICE SMITH, Notary Public.

Prepare for post-war reconstruction—

learn to "know your bearings" now



A heavy part of the burden of world reconstruction following the United Nations' victory in the war will have to be borne by graduate engineers, now in school.

Revolutionary advancements in machines of all kinds will be the order of the day and, among other things, you'll have to know your bearings in order to be able to hold your own when competition gets tough.

By getting a sound basic knowledge of Timken Tapered Roller Bearings and their application now, you will be that much ahead of the game when the time comes, for you will be prepared to solve any bearing problem that ever is likely to come up.

Furthermore, through the intelligent use of Timken Bearings you will be able to create machines that not only *perform better,* but also *sell better*—for wherever civilization exists, no name in bearings means so much to the machine buyer as "TIMKEN".

Our engineers—specialists in bearing design and application—will be glad to help you in your study of Timken Bearings.

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TAPES — RULES — PRECISION TOOLS

OUR SOCIETIES *(Cont. from page 16)*

A. S. A. E.

The first meeting of A.S.A.E. on October 6 was devoted to acquainting the members with two aspects of Civilian Defense. Mr. Fred Wiley of the local CD organization presented two sound films—*The Incendiary Bomb* and *The Air-Raid Warden.*

On October 12, Mr. Leslie Wright, Assistant State Co-ordinator of the U.S. Soil Conservation Service, addressed the group, choosing as his subject, *The Engineer and Soil Conservation.* His talk was highly appreciated in that it helped to answer the question foremost in the minds of most of us, namely, what is expected of us when we enter a particular branch of the engineering profession.

The Officers are arranging to have one of the engineers from the Ferguson Company—developers of the Ford-Ferguson Tractor—as the speaker at one of the regular meetings in the near future.

TAU NU TAU

On September 22, a rushing meeting of T.N.T. was held. Instructions were given in the field stripping of the 4.5 caliber pistol. As a result of this meeting, 34 pledges attended formal pledging on September 29. The honor system for cadets was discussed at the meeting of October 15. On November 3, the pledge period ended, and a personal defense demonstration was given by Coach Hek Kenney. On November 13 and 14, an Engineer unit and T.N.T. maneuver was held at Collison, Illinois. At the November 24 meeting, the army jeep was demonstrated. The annual T.N.T. formal dance is to be held at the Union Building on January 9, 1943.

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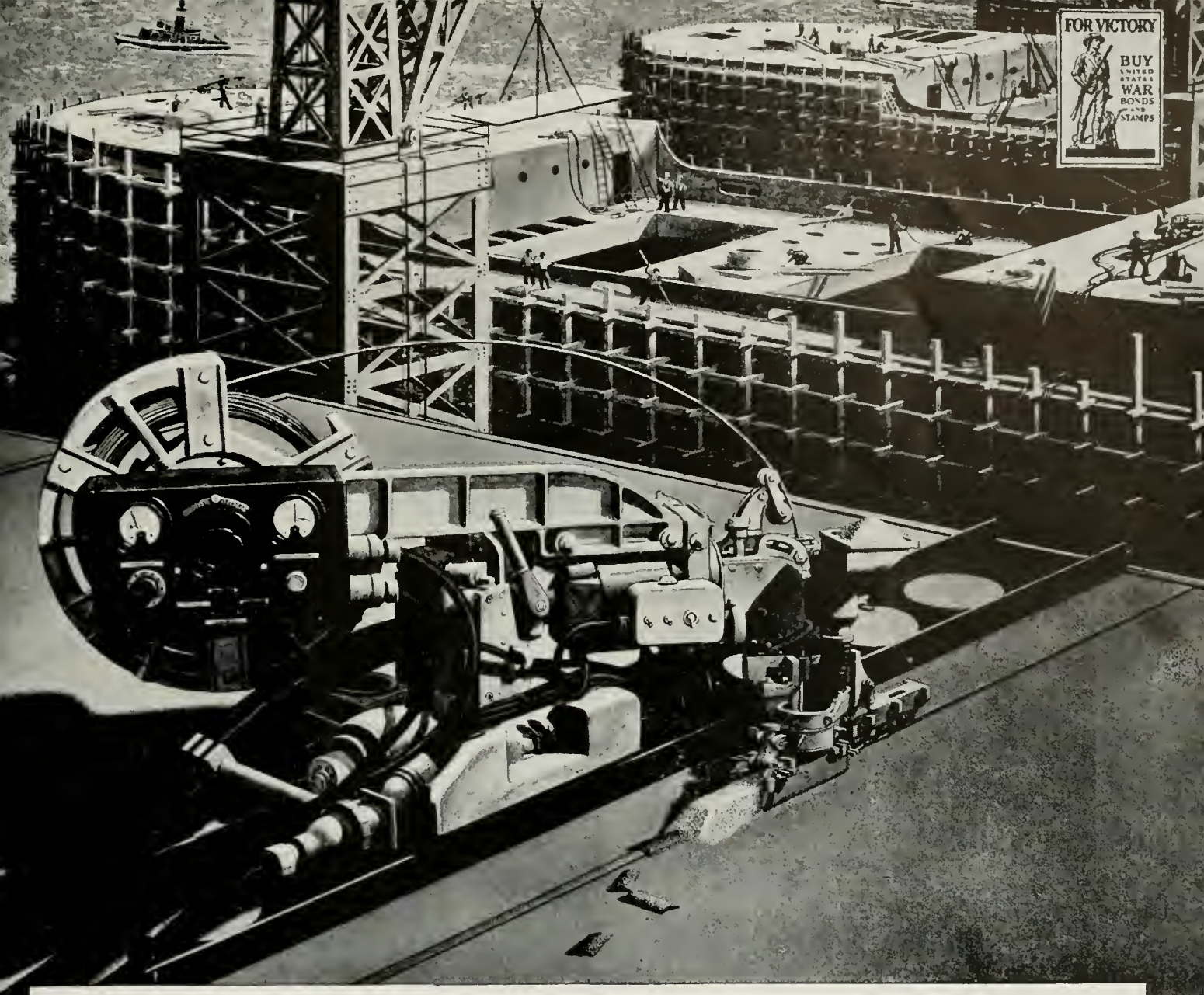


MAKING ONE-PIECE SUITS FOR *SHIPS!*

THERE'S NEWS on America's ship ways today . . . an amazing machine that unites steel plates without noise, fuss, sparks or visible arc! A process that is helping to construct those marvels of speed, strength, safety, and carrying capacity . . . "all-welded" ships!

This process . . . known as "Unionmelt" Welding . . . joins steel plates of any commercial thickness as much as 20 *times faster* than any other similarly applicable method! And it produces uniformly high-quality welds!

How does it work? A special welding composition . . . "Unionmelt" . . . flows from a hopper and blankets the edges to be joined. Within this granulated mixture, intense concentrated heat is generated by electric current. A bare metal electrode and the edges being welded are melted and fused. Some of the "Unionmelt" melts and remains as a temporary protective coating over the weld.

The process is completely automatic. Special apparatus feeds the "Unionmelt," the welding rod, and the electric current. Speed and current values are adjusted by an operator.

"Unionmelt" welding is also speeding up the construction of fighting tanks and chemical tanks . . . artillery mounts and aircraft parts . . . pressure vessels and locomotive boilers . . . pipe and pipe lines . . . and all kinds of heavy mechanical equipment.

Working with this unique process is an astoundingly fast Linde method of preparing steel plates for welding. White-hot oxy-acetylene flames . . . cutting simultaneously at different angles . . . bevel and square-up steel plates as fast as they are needed! Together, these two processes are speeding up the fabrication of key equipment at a remarkable rate.

Many years of research into welding, flame-cutting, flame-fabricating, and flame-conditioning of metals have given Linde engineers a vast store of useful knowledge about these methods. Have you a war production problem which might be solved by this "know how"?

The important advances in the cutting, conditioning and fabrication of metals made by The Linde Air Products Company have been facilitated by collaboration with Union Carbide and Carbon Research Laboratories, Inc., and by the metallurgical experience of Electro Metallurgical Company—which companies also are Units of Union Carbide and Carbon Corporation.

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

UCC

GENERAL OFFICES: New York, N. Y. Offices in Principal Cities

G-E Campus News

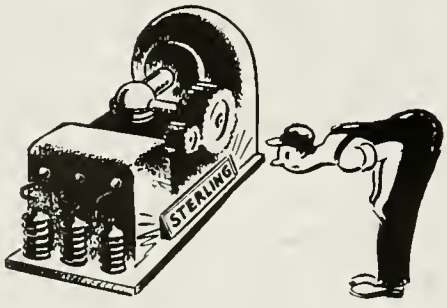
GIRLS, GIRLS, GIRLS

INASMUCH as only one-third of the 12,000 engineers who will graduate in 1943 will be available for private industry, General Electric is hiring young college women to do work formerly done by male engineers.

Forty-four "test women" are on the job now, and others will report each week until the quota (150) is reached. The girls will make computations, chart graphs, and calibrate fine instruments for use in the machine-tool industry.

Miss Virginia Frey (U. of Michigan), one of the 12 women in the country who received engineering degrees this year, is the only graduate engineer in the group. However, each of the others has majored in either mathematics or physics and has received training in both.

Although no one expects these girls to become full-fledged engineers, most of them will be given the Company's famous "test" course.



HI-YO, SILVER!

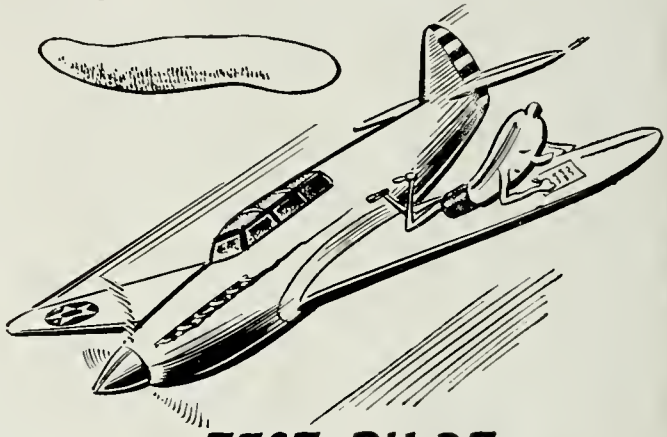
BROTHER, can you spare a dime?

Manufacturers don't really need it yet, but they are using more and more silver as other metals become increasingly difficult to get. G-E engineers, for example, are using silver in the manufacture of electric apparatus in order to conserve tin, copper, and other scarce materials.

There is now at least a little of the precious metal in almost every motor, generator, transformer, and other piece of equipment built by General Electric for the war.

In many cases the use of silver adds to the cost—a consideration secondary to production at present. Here its use is probably temporary.

But in current-carrying contacts and in brazing alloys, the use of silver results in an improvement in quality sufficient to justify the greater cost. For these purposes, silver will very likely be used in even greater quantities after the war.



TEST PILOT

THE versatile electronic tube has now become somewhat of a test pilot. On test flights, it goes along and writes a complete record of the strains on certain structural parts of the plane as it dives and twists and streaks across the sky.

When a fighter plane goes into a power dive at 500 miles an hour, for example, it has to withstand terrific strains. How great a strain is a vital question to the designer, who wants to know whether he can reduce the weight of the plane to give it greater speed.

Here's how the electronic tube helps furnish the answer to that question: strain gages measure minute changes in dimensions, converting them into tiny electric impulses which electronic tubes amplify sufficiently to drive a highly sensitive oscillograph galvanometer; the galvanometer makes a permanent record of the impulses on a photographic film. *General Electric Company, Schenectady, N. Y.*

GENERAL ELECTRIC

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ILLINOIS TECHNOGRAPH

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AIR TRANSPORTATION

MECHANISM OF MAGNETISM

PARACHUTES

SYNTHETIC RUBBER

A.S.C.E. CONFERENCE

OUR SOCIETIES

TECHNOCRACKED

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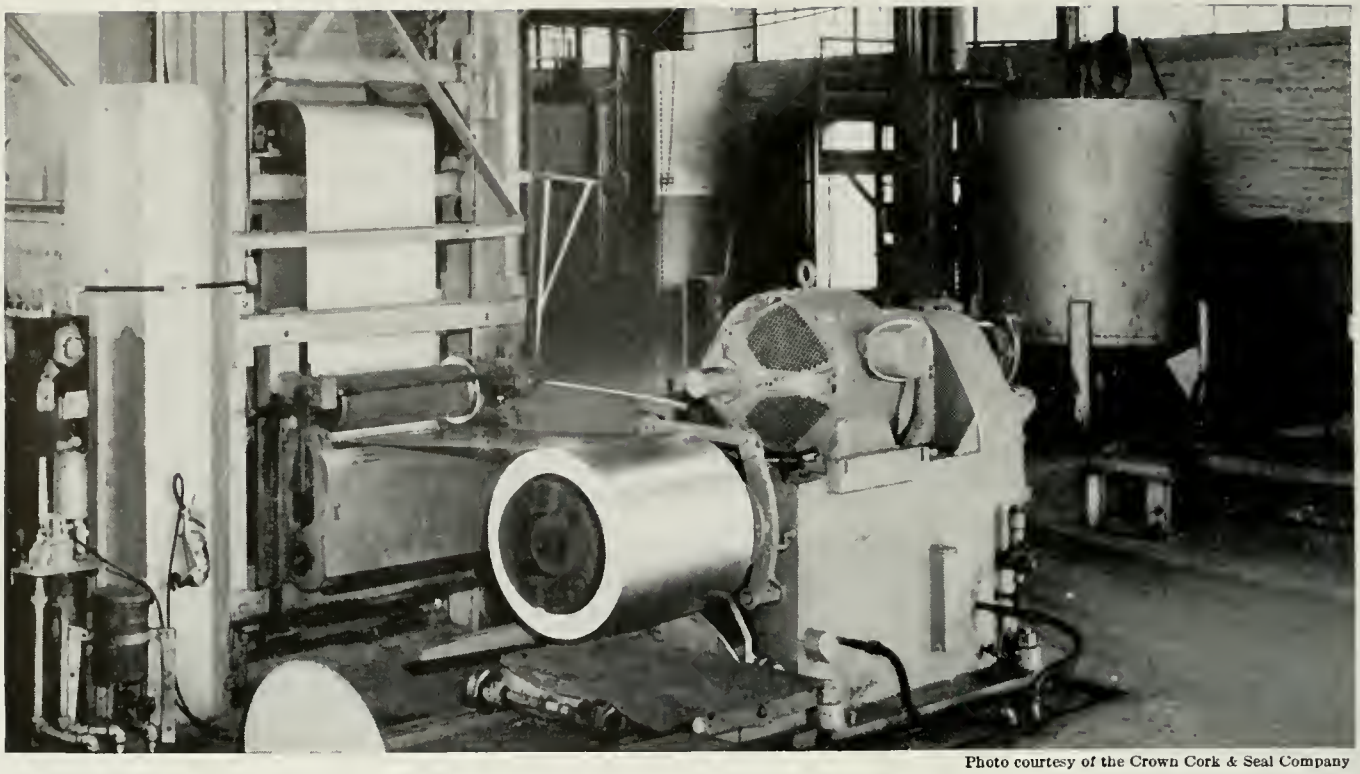


Photo courtesy of the Crown Cork & Seal Company

The best news about tin since we went to war

WHEN THE JAPS overran Malaya and the East Indies, they thought they had dealt a staggering blow to America.

For, overnight, tin became a most critical raw material, because America relies upon this bright metal for tin plate, bearing alloys, solder, collapsible tubes . . . *but mostly tin plate.*

However, Uncle Sam had an ace in the hole . . . *electrolytic tin plate.* In this process tin is deposited electrolytically . . . not hot-dipped . . . on steel strip. And only *one third* the normal thickness of tin is required.

Unfortunately, electrolytic tin plate is far from perfect as it comes from the plating baths. It is porous and not completely resistant to corrosion,

In order to make electrolytic tin plate usable, the tin deposit must be re-heated and *flowed* after plating. But until recently, even the best available re-heating and flowing processes were painfully slow.

Right here is where Westinghouse "know how" stepped into the picture.

R. M. Baker, Westinghouse Research Engineer, together with Glenn E. Stoltz, of the Westinghouse Industry Engineering Department, decided that the porous tin coating could be *fused* . . . through the magic of electronics . . . to give the tin plate the desired corrosion-resistant property and surface brightness.

Baker and Stoltz built a high frequency coil, using radio broadcasting oscillator tubes for their power source. Through this coil they passed electrolytic tin plate. The inductive heating effect melted the tin coating . . . and it fused smoothly and evenly over the porous surface.

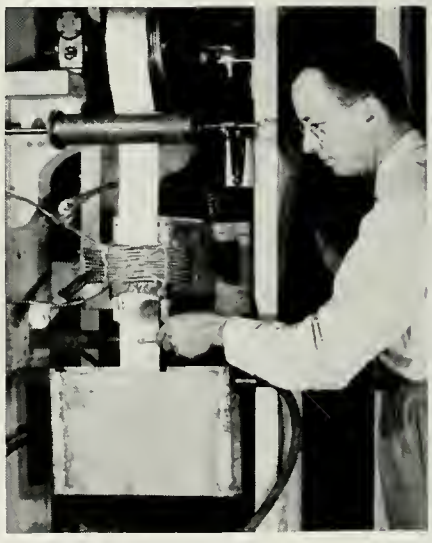
The new Westinghouse tin reflowing process is now in actual use, turning out gleaming ribbons of tin plate at better than 500 feet per minute. It will save many thousands of tons of tin every year!

• • • • •

What Baker and Stoltz did for the tin plate industry many engineering students in college today will do for other industries tomorrow.

Westinghouse knows where to find the future scientists America needs so badly on the industrial front . . . many will be among the technical graduates of the Class of '43.

Westinghouse Electric & Manufacturing Company, Pittsburgh, Penna. Plants in 25 cities, offices everywhere.



RADIO WAVES FUSE TIN . . . R. M. Baker, Westinghouse Research Engineer, examines a test strip of tin plate which is passing through the experimental tin flowing mill. Baker joined Westinghouse after receiving his B.S. at Texas University. He earned an M.S. degree at the University of Pittsburgh.

Westinghouse

. . . making Electricity work for Victory

FOR MORE THAN a decade designers of aircraft have foreseen the day of freight-carrying planes flying the airways of America. Now, with Dow successfully extracting weight-saving magnesium from sea water, the era of commercial freight transport by air draws measurably closer. Vast quantities of this lightest of structural metals are being used in the construction of aircraft for our armed forces and will eventually be available for industry at large after Victory is won. Thus from the waters of the sea will come wings destined to transport many of the nation's products of peace by air.

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Son...

HE has just turned eighteen. Shaves twice a week and maybe a hair or two is sprouting on his chest. He shies away now when his dad tries to be affectionate and we noticed some lipstick on one of his handkerchiefs after a country club junior dance not so long ago. But it seems only yesterday, perhaps it was the day before, that he was a chubby legged kid swinging from the arch of the doorway, leading to the dining room, in a gadget that was something like a breeches buoy and he was sucking at the end of a turkey bone.

He went back to school this Fall, a tall, athletic lad, budding into manhood, but there was something else on his mind beside the football and hockey teams or the little blonde girl with whom he had "palled" around during the Summer. It seems as though he was listening for a certain call—the Clarion call that poets sing about—and, perhaps we just imagined it, but we thought we saw an upward jutting of his chin, a certain light in his eyes, and a sort of a rearing-to-go expression in his face.

It chilled us a bit in the region of our heart, when we thought of his discarding the sports coat for the "O.D." of the Army or the blue of the Navy. There was a bit of a catch in our throat as we thought of his putting aside his football helmet for one of steel; of his hanging up his hockey stick and reaching for a gun. After all we still regard him as just a little boy.

They tell us that the eighteen and nineteen year old lads are to be called to the service. When that day comes to us there will be prayers, but no tears. We shall not mourn nor shall we be fearful. Rather there will come welling up from our hearts that warm feeling of pride that millions of other parents will sense when their beloved lads marched away. Our lad is no different than the others. We are no different than other loving parents, nor is our sacrifice any greater. They are going to make great soldiers, sailors, marines and fliers out of these youngsters. And they will become a mighty force when they take their places beside their brothers in arms. They too know what they fight for. They too know full well of the sacrifices that must be made before the evil powers that threaten the world can be overcome.

And let us not forget that they are counting on us. They know that we shall not fail them.

God be with them and their brothers.

THE CARBORUNDUM COMPANY, NIAGARA FALLS, N. Y.
REG. U. S. PAT. OFF.

DECEMBER ★ 1942

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Published Eight Times Yearly by the Students of the College of Engineering, University of Illinois

Published eight times during the year (October, November, December, January, February, March, April, and May) by The Illini Publishing Company. Entered as second class matter, October 30, 1921, at the post office of Urbana, Illinois. Office 213 Engineering Hall, Urbana, Illinois. Subscriptions, $1.00 per year. Single copy 20 cents.
Reprint rights reserved by *The Illinois Technograph.*

Frontispiece . . .

Electric power generation and transmission. *(Photomontage, Courtesy General Electric).*

★

Cover . . .

Three Aircobras in formation. *(Photo. Courtesy Bell Aircraft Company).*

GENERAL ELECTRIC

AIR TRANSPORTATION

By M. L. ENGER
Dean of the College of Engineering

The war has crowded into a few years the development of air transportation which would have required decades under peace time conditions. Planes are being produced in numbers which seemed fantastic when first mentioned. Flights over oceans have become routine. After the war we shall have an over-expanded manufacturing capacity for planes of every type and a reservoir of pilots and other personnel needed to put them into use. The inevitable result will be a revolution in transportation which will produce social and economic effects of great consequence.

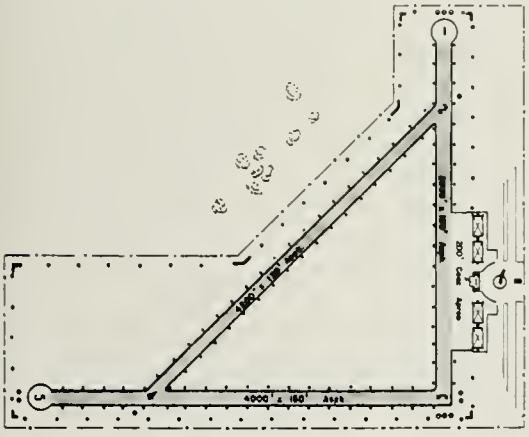
The growth of air transportation was very rapid before the war. Each succeeding year saw a great increase in the air transport of passengers, mail, and express. However, at its peak, air line service was available over a limited number of routes, and only a few hundred planes were in service. After the war there will be a great and sudden increase in all phases of air transport. Large cargo planes will compete with railroads for the perishable freight business. Smaller transport planes, and possibly gliders, will compete with trucks. Long distance passenger travel by airplane will increase. Air transportation is destined to become one of the great industries after the war.

A very large number of airports will be necessary before it will be possible fully to develop air transportation. Just as vast expenditures have been made for paved highways for automotive transportation, great expenditures for airports must be made for transportation by air. The time required to construct an adequate number of airports will be the principal factor in retarding the use of the airplane. The existing capacity for manufacturing airplanes exceeds by many times the available airport capacity. It follows that airport construction will be one of the major engineering activities in the decade following the war.

The Civil Aeronautcs Administration several years ago proposed Federal aproprations for a system of airports and airways which were attacked as fantastic and visionary at that time. It is evident now that the proposed system represented a very modest beginning of the much more comprehensive plan which is known to be needed.

Airport planning and construction is in its infancy. Many airports have been abandoned as unsuitable after large expenditures had been made, because of inadequate areas or unfavorable locations. The Civil Aeronautics Administration recommends a square mile of land for important airports and has set up standards for runway lengths, widths,

(Continued on Page 27)



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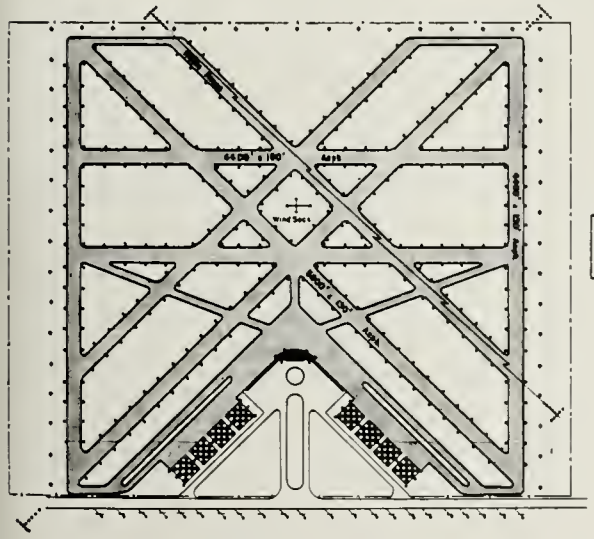

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LANDING STRIPS 4500' LENGTHS AND OVER

Recommendations of Airport Section of Civil Aeronautics Administration for Airports for use of Transport Aircraft.

The Mechanism of Magnetism

By SIDNEY SIEGEL
Research Engineer, Westinghouse Electric and Manufacturing Company

Nearly a half-billion pounds of iron is used in the United States yearly for electrical purposes. The reason is, of course, that iron is the material most readily capable of becoming magnetized. Just what happens inside a transformer lamination or a lifting electromagnet element has been thoroughly explored and it is possible to describe fully and clearly the phenomena occurring while iron is being magnetized.

From the magnetic point of view, all substances can be grouped into two classes. In the first, the paramagnetic materials (such as aluminum, calcium, platinum, tungsten), the atoms of the substance have a permanent magnetic moment; ie., each atom even in the absence of an external field is a tiny magnet. The substances of this class all have nearly the same magnetic moment per atom, several atomic units of magnetism. Each atom is a miniature solar system in which free electrons revolve around a heavy nucleus of protons and neutrons. In addition to revolving about the nucleus, each free electron is also believed to spin about its axis, thereby producing a magnetic moment corresponding to the atomic unit of magnetism. The magnetic moment of the whole atom depends, of course, on the number of unpaired electrons in the orbits surrounding the nucleus.

When a paramagnetic substance is placed in a magnetic field, the atomic magnets tend to line up in the direction of the field against the disorienting effect of the random thermal vibration of the atoms. Most of these substances have a permeability (ratio of magnetic induction to magnetizing force) of the order 1.001, and are only weakly magnetized in the ordinary magnetic fields encountered in practice. The reason for this is that the disorienting effect of the thermal agitation, at room temperature, is far larger than the orienting effect of the applied field.

In the second class of substances, the atoms have no magnetic moment in the absence of an external magnetic field. These are the diamagnetic materials (such as silver, gold, zinc, bismuth), and have permeability less than unity, but by an amount so small that very sensitive apparatus is required to detect the difference. For example, the permeability of pure copper, which is diamagnetic, is 0.999999. For all practical purposes, all diamagnetic and most paramagnetic substances are usually designated "non-magnetic" due to the fact that their constant of permeability is nearly unity, within one part, or less, in 10,000.

A small group of paramagnetic materials namely, iron, cobalt, nickel, alloys and compounds of these metals, and certain alloys containing manganese, differ radically from all other substances. The outward difference between these materials, called ferromagnetics, and other paramagnetic materials, is in the magnetic properties and is well known. As shown in Fig. 1, it is possible to induce high flux densities in iron. These flux densities are much higher than those in most paramagnetic materials—about 1000 times as high. The reason for this difference is that in the ferromagnetics there is a strong interaction between the individual atoms of the solid tending to line up neighboring atoms so that the atomic magnets are parallel ,while in the paramagnetics there is no such interaction.

Ferromagnetic atomic interaction is so great, even without an external field, that a comparable magnetization intensity of the same magnitude in a paramagnetic metal could only be achieved by means of an external field of some 10 million oersteds. Such intense fields have never yet been attained by laboratory or commercial apparatus. (The oersted is the unit of magnetic field strength, equal to 1/0.4 pi ampere turns per centimeter. The earth's magnetic field is about one oersted; the exciting field in a transformer about ten oersteds, and the field in the air gap of a generator is about 10,000 oersteds.)

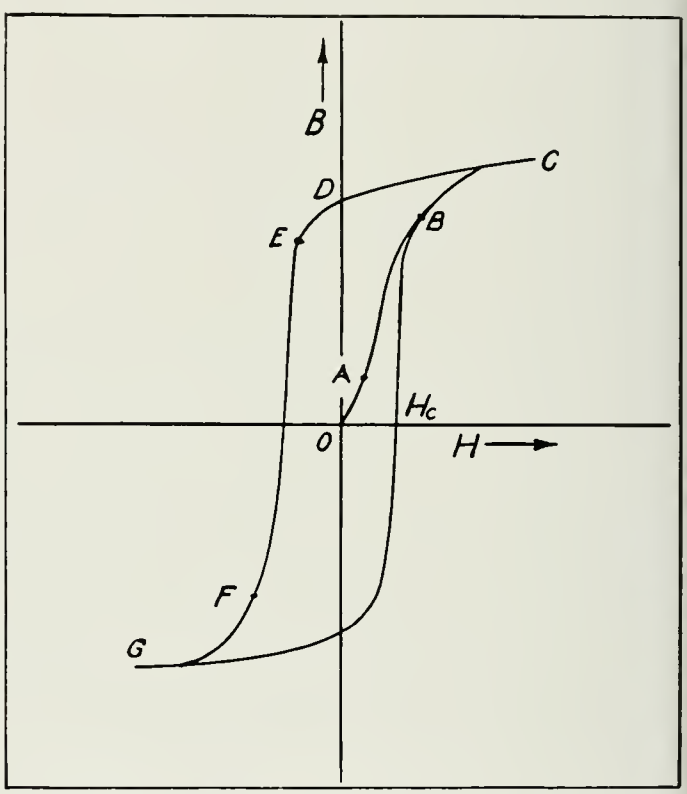

Fig. 1.—The magnetization curve of a ferromagnetic material with the induction B plotted vertically, the magnetizing field H plotted horizontally. A number of magnetization principles, discussed in the text, are indicated on the curve.

One feature of our picture of a piece of iron is, therefore, that nearly every atomic magnet is parallel to its neighbors, because of the interaction between neighboring atoms, even in the absence of an external field. This view, that ferromagnetic materials are spontaneously magnetized, is essential to our understanding of the behavior of a piece of iron in a magnetic field, and was first set forth by Weiss.[1]

If all the atomic magnets are parallel without an external field, how is it possible to obtain a demagnetized piece of iron? Weiss provided the answer to this question, too, by explaining that each piece of iron is divided into minute "domains of spontaneous magnetization." In each domain the atoms are all parallel, so that each domain is saturated; i.e., within each domain the ferric induction (fig. 1) is equal to its saturation value of about 20,000 gausses. The direction of the induction varies from one domain to another in such a manner that the induction of the specimen as a whole is zero, and the specimen is therefore demagnetized. In other words, whereas in each domain all—or most all—the atoms are oriented, the domains themselves are disposed at random, giving zero net magnetization.

The size and shape of these domains depend to some extent on the size and shape of the specimen, and on the nature of the material, but in a general way the dimensions of the domains are of the order one-tenth to one-thousandth cm, each containing about 10^{15} (a million billions) atoms. The domains exist as a result of a balance between two opposing types of forces. Consider a cylindrical single crystal of iron, such as is shown in Fig. 2a. The atomic interactions tend to make all the atoms parallel to each other. Were this tendency satisfied, the bar would be saturated and magnetized in the direction shown. The magnetic poles at the end faces of the crystal would give rise to a demagnetizing field in opposite direction to that in the crystal. This field would tend to reverse the atomic magnets. However, another force opposing the magnetization in the crystal is the thermal agitation tending to orient the atomic magnets in all directions. As a result, to preserve equilibrium, the crystal becomes divided into small regions, Fig. 2b. Each region contains a large number of atomic magnets oriented in one direction, and is therefore magnetized in the same directions, and the net result is that the crystal, or the whole piece of iron of which the crystal is but a part, is demagnetized.

The existence of these domains has been proved by many experimenters, the first direct visual evidence having been Bitter.[2] If a properly prepared collodial suspension of iron oxide is placed on the polished surface of a ferromagnetic material, and the surface examined under the microscope, patterns such as those of Fig. 3 are observed.

All metals are crystalline, which means that their atoms are regularly distributed on the points of a space lattice. For iron crystals this lattice is a series of cubes each 2.86×10^{-8} cm (about one-hundred-millionth inch) on edge, with an iron atom at each corner and at the center of each cube. Since in a piece of iron such as a transformer lamination each crystal contains an enormous number of very regularly arranged iron atoms. Each crystal is divided, as we have seen, into many magnetic domains. The regularity of position continues from one domain to another within a single crystal, but the regularity of direction of atomic magnetic moment is continuous only over a domain. This situation is pictured in Fig. 2b. In iron these domains are not randomly oriented, for each domain is magnetized to saturation along one of the six possible directions parallel to the cube edge of the crystal in which the domain is situated.

Our picture of a piece of demagnetized iron is therefore the following: Crystal grains about one-tenth cm in size are more or less randomly oriented in the iron. Within each grain, many saturated domains of magnetization are present, with the direction of magnetization of any one domain restricted to one of the cube-edge directions in that crystal. There is an equal number of domains in each direction, so that each crystal shows no net magnetization, and the specimen as a whole is demagnetized. This condition is shown schematically in Fig. 3a, where two grains are shown, each divided into idealized square magnetic domains. The cubic axes lie along the lines in each crystal, and each domain is magnetized in the direction indicated by the arrows. Ths material is demagnetized, in the state given by the point 0 on the magnetzation curve of Fig. 1.

A small positive field is now applied, and the magnetization increases along OA in Fig. 1. This initial increase in magnetization occurs by a process of domain-boundary displacement. This is shown in Fig. 3b. Domain 1 in the upper crystal, for example, grows at the expense of its neighboring domains by shifting its boundaries to the position of the dotted lines. By this process, all the domains that are favorably oriented with respect to H, i.e., magnetized at a smaller angle with the applied field, grow at the expense of their less favorably oriented neighbors. This process is a nearly reversible one, and if the field is removed, most of the domain boundaries return to their original positions.

If the applied field is increased, and becomes of the order of the coercive force H_c, which in well-annealed, high-purity materials may be only a fraction of an oersted, a new process of magnetization comes into play. The boundary between domains shifts suddenly so as to wipe out entirely an unfavorably oriented domain, such as domain 2 in the upper crystal of Fig. 4b. This sudden shift of domain boundaries, in which entire domains change their direction of magnetization from one cubic axis to another, is known as the Barkhausen effect. Bozorth[4] has shown that practically all the change in induction from A to B in Fig. 1 occurs by this process of domain-boundary shifts. Because of these changes in induction occur rapidly, in about one ten-thousandth second, local eddy currents are induced in the neighborhood of each domain, and these dissipate energy. This energy is supplied from the power source that provides the current to magnetize the specimen, and is dissipated as heat in the iron. This part of the magnetization curve is not reversible; if the field is reduced, the portion BA is not retraced.

The magnitude of the field, H_c, at which there processes occur, is of great importance for the coercive force determines to a large extent the amount of energy dissipated as hysteresis in a cycle of magnetization. Detailed experiments on the energy dissipation during various parts of the cycle show that almost all the energy is lost on the steep part of the magnetization curve. It therefore appears quite probable that the loss is a result of these discontinuous boundary emotions. Extensive investigations by Yensen[5] have shown that the magnitude of hysteresis loss depends primarily on the impurities present in the material and on the internal strains in the structure of the specimen.

The position at which a domain boundary is situated is determined by the manner in which random internal stresses vary from point to point within a crystal. The ease with which such a boundary can be made to move; i.e., the field required to cause a sudden boundary shift giving rise to a Barkhausen jump in magnetization, depends on the internal

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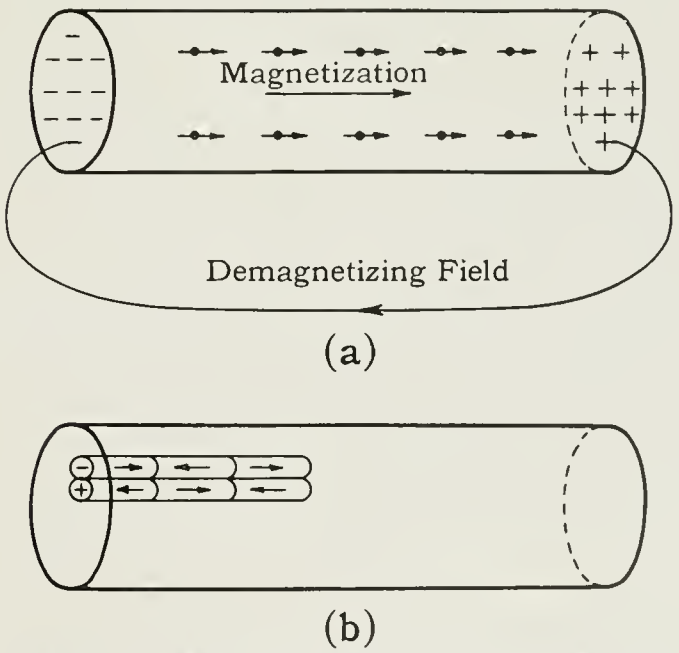
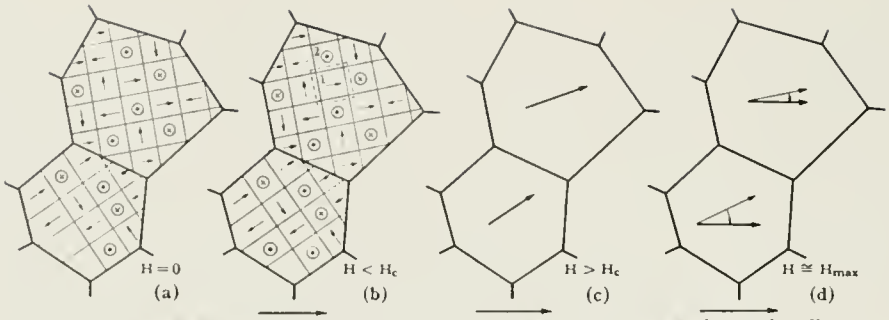


Fig. 2.—(a) A single iron crystal which is entirely saturated because of the atomic interactions that tend to make each atom parallel to its neighbor. A demagnetizing field opposite in direction to that of the magnetization is produced. (b) Crystal divided into small magnetic domains so arranged that the sample as a whole is demagnetized, with no resulting external demagnetizing field.



a) Two grains, each one divided into idealized square magnetic domains whose magnetism is in the direction indicated by the arrow. As there is an equal number of domains in each direction, the grains as a whole are demagnetized. (b) The two grains are now subjected to a small positive field, which causes a slight domain boundary displacement. Domains favorably oriented with regard to the field are enlarged and those unfavorably disposed are made proportionately smaller. (c) Two grains showing completion of reversals of magnetism of individual domains and each crystal in effect a single domain with magnetic saturation along the cubic axis making the smallest angle with the applied field. (d) Saturation magnetization in each crystal swings gradually from the cubic axis of the crystal toward the axis of the applied field, when the applied magnetizing field intensity is sufficiently large.

Fig. 3.—Grains showing effect of applying a magnetic field as shown in Fig. 1

stresses in the interior of a grain. If there are many impurities, or if there are internal stresses as a result of plastic deformation, these distort the lattice of the crystal and make the boundary between domains difficult to move; i.e., act as a sort of domain friction. As these impurities are removed, and as random internal strains are relieved by annealing, thereby lessening lattice distortion, the field H_c required to make a boundary move becomes smaller, and as the coercive force decreases the hysteresis loss decreases.

At this point it is appropriate to ask, "What is the correlation between mechanical strains and magnetic properties?" To answer this it is necessary to consider another magnetic phenomenon, magnetostriction. A piece of iron on being magnetized becomes longer by a very small amount, the longitudinal strain being about one part in one hundred thousand. Look again at Fig. 3b, and assume first that the material has no internal strains other than those caused by magnetostriction; i.e., that it is of high purity and has been properly annealed. Because of magnetostriction, domain 1 which is magnetized to the right is longer by one part in a hundred thousand in that direction. In order for the magnetization in domain 2 to change suddenly to that of domain 1, it is obviously necessary for the magnetic field to perform useful work against the elastic force caused by magnetostriction. The field strength necessary to perform this work in pure iron was found—both by calculation and experiment—to be approximately 0.04 oersted. Since the internal strain due to impurities or cold work may be on the order of the elastic limit, a strain of $\Delta l/l = 10^{-3}$, the coercive force in such a case can be hundreds of times larger than it is in pure, well-annealed iron.

In most magnetic materials these discontinuous reversals of magnetization of individual domains are completed in fields of the order of several oersteds. The situation is now that depicted in Fig. 3c. Each crystal is in effect a single domain magnetized to saturation along that cubic axis making the smallest angle with the direction of the applied field H. While each grain is now saturated, the specimen as a whole has only the magnetization corresponding to the point B in Fig. 1, because crystals themselves are randomly oriented and contribute only the component of the saturation magnetization parallel to H. The amount of induction at the point B is determined primarily by the orientation of the crystal grains in the specimen. The two grains of Fig. 3d are randomly oriented. The component of B along H in the upper grain is about 90 per cent of saturation; in the lower grain it is 75 per cent of saturation. Such a material therefore has a lower permeability in fields of the order 10 oersteds than one in which the grains are oriented with a cubic axis along H. In the latter case each grain contributes its full saturation magnetization to the component of B along H. This property of iron, that the cubic axis is a direction of easy magnetization, is the basis for the higher permeability of the new magnetic material Hipersil, in which nearly all the grains are oriented, with a cubic axis along the direction in which the flux traverses the material.

If the flux is further increased, up to several hundred oersteds, the portion BC of the magnetization curve is followed. This rather slow approach to saturation at C is achieved by a process in which the direction of magnetization in each crystal rotates gradually from the direction of the cube edge to that of H. This process is shown in Fig. 3d, and at its completion the entire specimen is saturated. This rotation process is nearly reversible, and is accomplished by little dissipation of energy.

In following the magnetization curve from the demagnetized state at D, we have encountered three magnetization processes; first, the boundary displacement in fields less than the coercive force; second, the Barkhausen process in which entire domains suddenly change their directions of magnetization in fields of intensity approximating that of the coercive force; and, third, the slow, reversible rotation of the magnetization of entire crystals in relatively large fields until saturation is attained at the point C of Fig. 1. In a cycle of magnetization, such as occurs in an electrical machine, only the last two processes are constantly repeated; the first takes place only once. Thus in going from C to E we have mainly reversible rotations, in going from E to F almost entirely discontinuous jumps of the Barkhausen type, and from F to G again reversible rotations. The remainder of the cycle is of course identical with the portion CDEFG.

To summarize, in the demagnetized state, each crystal is divided into a large number of domains, each magnetically saturated along one of the cubic axes of the crystal. The saturation magnetization in each domain is determined entirely by the atomic properties of iron, and cannot be changed except by adding alloying elements to iron. When the field reaches the coercive force, favorably oriented domains grow at the expense of less favorable oriented domains. The magnitude of the coercive force depends on random internal stresses because of impurities or cold work, and can be greatly reduced by purification and strain-relief annealing. The final process consists of a slow approach to saturation through the rotation of the direction of magnetization in each grain from that of a cubic axis to that of the field. The magnetic induction at which this process begins depends primarily on the orientation of the grains, and can be controlled by special rolling and heat treatments, yielding a material such as Hipersil with pronounced grain orientation.

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PARACHUTES . . .

By WILLIAM G. MURPHY, C. E. '43

There is no feat of modern war that amazes and excites the lay public more than the Parachute Battalions dropping to attack by surprise some strategic position behind the enemies lines. In almost every newspaper there are accounts of investigations to determine the whereabouts of a parachutist reported to have fallen from the clouds. The development of the parachute for modern warfare has made people conscious of the danger of attack even in these spots remote from any theatre of war, but the parachute even today is still serving a purpose, the one for which it was developed, greater than that of transporting troops to a spot of launching a surprise attack. This purpose is the one that the Chinese and Leonardo da Vinci were thinking of when they conceived the idea of a free fall from the sky without injury, that of saving lives.

The early days of the parachute date back to the balloonist of the carnival era who used them to save themselves when their balloons caught fire. The unimaginative people of the time did not foresee the possibilities of the parachute; and therefore, progress was limited to a few courageous pioneers who experimented with different purposes but toward the same end — a safe fall from any height.

Andrew Jacques Garnerin, a Frenchman, is credited by all as the first parachutist even though there is some doubt as to whether he actually made the first jump. His first jump was on October 22, 1797 in Paris, France from a height of about 2000 feet. Five years later he is believed to have ascended to 8000 feet, but on this jump the "chute" oscillated and Garnerin was badly shaken up.

Another Frenchman, Lelande, is given credit for solving this problem by his suggestion that hole cut in the top of the canopy would equalize the pressure on the inside. This reduced the oscillation but "chutes" still rock, violently at times, and make the landings hazardous for the chutist.

In July, 1808, the parachute saved its first life when Kuparento, a Polish baloonist, was forced to jump when his baloon caught fire. In spite of the attempts of many men to develop the parachute, it remained only an amusement device for carnival and circus crowds until the development of the airplane.

In the early days of aviation many jumps were made, but Grant Morton is reported to have jumped from a plane in 1911. Captain Albert Berry made two jumps from a static "chute" in 1912 over St. Louis, Missouri. These were the first jumps recorded. Parachutes to this date were makeshift models that the jumper had made himself.

No aviators at this time considered the parachute as a safety device, and anyone who wore one was either a sissy or fool. French aviation officials were of a different mind on the problem. Colonel Lalance offered a prize and many experimental chutes were tried. None were satisfactory.

The period from 1914 to 1925 was very important in the growth of the parachute. Many observation baloonists lost their lives in flames when they fell in burning baloons. These caused the British government to develop a "chute" to be used by these men. The French and Germans also developed parachutes for the same purpose. Nearly a thousand lives were saved by chutes following this new use.

To offer some protection to pilots both the Germans and the Allies experimented with static line chutes. The static line was a cord of some sort which was fastened to the plane and pulled the chut from either a pack on the pilot's back or a seat pack as he jumped.

At McCook Field, Dayton, Ohio, the United States Army was making experiments which were not dropped at the end of the war. Major E. 1. Hoffman was placed in charge and he and his staff made many valuable experiments in parachute design.

These men after many failures developed the forerunner of today's "chute of many purposes." All manufacturers of parachutes must use the Army-Navy specifications. Technical data, test records, and information showing the breaking strength, weight, thread count, tensile strength, and data on all other chute characteristics must be submitted. When this is aproved, functional tests using a 170 lb. dummy followed by a 600 pound lead weight and finally two live jumps with a rate of fall of not more than 21 feet per second. The chute must come through 100%. In addition the chute must be tested every sixty days.

Floyd Smith, one of the original group at McCook Field, is still active today as a manufacturer of parachutes. They are using a fifty foot steel tower with a swinging beam that rotates at 200 miles per hour. This invention proves itself invaluable time after time by enabling new designs to be tested without endangering the lives of test men.

In recent years the parachute has been used for many purposes such as carrying meterological equipment safely back to earth after registering conditions at high altitudes, dropping food and supplies to isolated communities, dropping medical supplies and doctors quickly at needed places, and perhaps the most spectacular, carrying soliders to a scene of battle.

Parachute troops are a recent addition to modern armies, but the idea is not new. Benjamin Franklin suggested dropping armies from the clouds in balloons while serving as our ambassador to France in 1784. It is also interesting that General Billy Mitchell first conceived the idea of a parachute army in modern times. In 1928 he arranged a demonstration and dropped a machine gun squad from Martin bomber. The operation was successful, but, was filed in the War Department and forgotten until some other country advanced the idea and used it with much damage.

The most important phase in the parachute is its growing importance in the field for which it was developed. Today many valuable, highly trained men are jumping safely from disabled planes to return to duty.

* * *

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Synthetic Rubber—New Major Industry

By BYRON WELSH, M. E. '43

The only ingredient lacking in the United States for the production of ample quantities of good-quality, low-cost synthetic rubber is time. This country has all the basic materials in abundance. It has the know-how; in fact, one major problem has been which of several entirely practical products to select. Even the machinery for making synthetic rubber is familiar to United States industry; much equipment that has been used for years in petroleum, chemical, and rubber industries is applicable with modifications. However, an industry doesn't grow from an annual production of less than ten thousand tons to nearly a million tons—a hundred-fold increase—overnight. Not even in the United States, scene of many industrial miracles, can that happen.

The motorist, with an eye on the calendar and another on his fading tires, can be sure of only one thing. He will eventually get tires made of synthetic rubber and they will be as good or better than those before Pearl Harbor, although possibly not at first. Whether he gets them soon enough to keep his car going depends on how quickly synthetic-rubber plants can be built, and upon how much and for how long rubber is needed by the armed forces. This last is unknown; but out of the welter of plans, arguments, discussions, and investigations, which has appeared to be only confusion, the synthetic-rubber program is taking definite shape.

Plans are laid, plant designs are drawn, and equipment has and is being purchased for a total plant capacity of about 800,000 tons yearly. As of July 15, 700,000 tons of this annual capacity is scheduled to be the kind known as Buna S. Of the remainder about 60 per cent will be of a type recently announced, called Butyl, and 40 per cent of neoprene. Several other rubber-like materials may give an additional 50,000 tons yearly. It is expected that some 200,000 tons of the Buna S will be made from ethyl alcohol, which can be produced from agricultural products, petroleum, or coal tar. Thus, in the race of the several types it appears that w can expect Buna S to win, Butyl to place, and neoprene to show. Also, there is a dark horse, Thiokol, the oldest of them all, that may make a strong showing as the race progresses.

Four of the major rubber companies each have 15,000- or 30,000-ton plants that are or soon will be in operation. The first of the new government-financed plants should be producing early next year. It is expected that by the end of 1943 half or more of the total projected plants will be ready, and the remainder going full tilt sometime in 1944.

The 1938 rubber consumption was 660,000 tons. The program for synthetic rubber plants of nearly a million tons annual capacity for installation before the end of 1944 seems to give the answer as to "when." But it doesn't. It is estimated that not over 25,000 tons of synthetic rubber will be produced this year, possibly 350,000 tons in 1943, and 750,000 tons in 1944. Probably none of the 1944 production, and certainly none before then will be available for non-essential use. Little, if any, will remain after supplying our own military forces, essential civilian needs, and — what is so often overlooked — replenishing the dwindling rubber stocks of the United Nations. Synthetic rubber for your car and mine after 1944? Perhaps.

When chemists start out to simulate a product of nature, they ordinarily seek first to determine the molecular structure of nature's product, and then to duplicate it by factory methods. Nature makes the latex that flows between the inner and outer bark of the rubber tree by building a complex molecule from many simple molecules of a hydrocarbon called isoprene. This much was learned over eighty years ago but scientists have never been able to discover the secret of how the transformation is made, or exactly what the final molecular structure is, or — for that matter — the purpose of the latex. Not until chemists gave up trying to duplicate nature were they able to produce an acceptable synthetic rubber. This has proved fortunate

Courtesy Westinghouse.

because in endeavoring to match the properties of rubber instead of duplicating its chemical structure chemists have produced many rubber-like materials in many ways superior to natural rubber.

During World War I the Germans, under the pressure of dire necessity, made 2500 tons of so-called methyl rubber. It was of inferior quality, and the process was abandoned. The rapid gyrations in price of crude rubber after the war (reaching a maximum of $1.23 per pound in 1925) spurred research in Germany, Russia, and the United States. Out of that research has come not one but several synthetic rubbers, each important because of special characteristics.

Chemists in Europe discovered that a rubber-like substance can be made from butadiene, a hydrocarbon. In the presence of water, an emulsifier, and sodium serving as a catalyst, and with proper heat and pressure, 2000 or 3000 of the fundamental butadiene molecules (C_4H_6) are induced to join hands with each other, chain fashion. This chain-like structure is a fundamental characteristic of all rubbery substances. The chemical process by which many simple molecules are joined into a giant one is polymerization.

Germans later found that mixing small proportions of other substances with butadiene results in a better product. One such substance is styrene, which is added to the butadiene in the proportion of about one to three, to form Buna S. The second substance combined (co-polymerized) with butadiene to form a synthetic rubber is acrylonitrile, the resulting product being known as Buna N, or Perbunan.

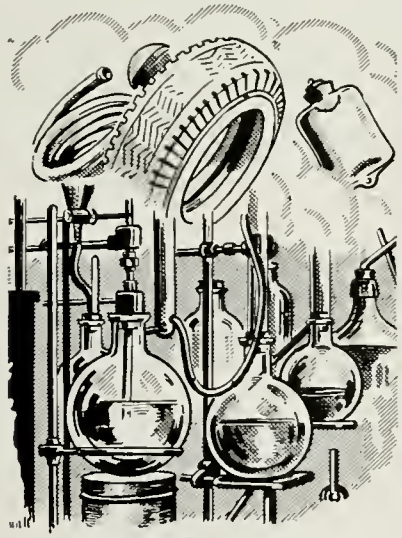
Buna S is the rubber used by Germany and Russia for their fighting forces. Accurate production figures are not available but it is believed that Germany, with coal as a source, produced about 3000 tons of Buna S rubber in 1937; 10,000 tons in 1938, and 20,000 tons in 1939. Reliable recent estimates are not available but present production is undoubtedly much higher. Production of Buna S in Russia, from alcohol, started earlier, has been much higher. Beginning with about 5000 tons in 1933, it had grown steadily to about 50,000 tons at the outbreak of the war.

While chemists in Europe were working with butadiene types of rubber, research men in the United States were busy along different lines. In 1931, Dr. J. C. Patrick, a research chemist for Armour & Company in Kansas City, mixed ethylene dichloride (Prestone) and sodium polysulfide together, in a search for a better anti-freeze. He expected a liquid. Instead a gummy mass resulted that looked, felt, and acted like rubber. This was Thiokol, the first commercial synthetic rubber produced in the United States.

In 1925 Julius Nieuwland, professor of chemistry at the University of Notre Dame, presented a paper on acetylene before a group of chemists. In his audience was Elmer Bolton, of the DuPont laboratories, who had been working on synthetic rubbers. Bolton saw in Nieuwland's results the missing key by which he was able to produce, in 1932, a product now known as neoprene. Neoprene has many rubber-like properties, yet it contains 40 per cent chlorine, which is not present in natural rubber.

Other synthetic rubbers followed in rapid succession. In 1933, a patent was granted to B. F. Goodrich Company on Koroseal, a plasticized polyvinyl chloride, that has many desirable properties of rubber. The Standard Oil Company of New Jersey developed in this country a rubber-like product from isobutylene, a petroleum product. This is called Vistanex, and was originally produced in Germany as Oppanol.

Chemists of large rubber companies in Akron also developed butadiene typed of synthetic rubbers which are



—Courtesy Westinghouse.

being made in commercial quantities. Instead of combining styrene or acrylonitrile with butadiene they are using other, but undisclosed substances. The Goodrich-Phillips Petroleum product is known as Ameripol. The Goodyear variety is called Chemigum, of which there are three grades of hardness.

Newest of synthetic rubbers is Butyl, another product developed by Standard Oil Company of New Jersey. Butyl is made almost entirely from isobutylene obtained from petroleum, and a small amount of butadiene. This rubber may become very important. As compared with other Buna rubbers, the raw material cost is lower. Also it can be produced by a continuous process, instead of in batches, as is necessary at present with Buna rubbers. Butyl-producing plants are cheaper to build and require lesst steel and other strategic materials. It appears that tires made of Butyl, while not as good as from Buna because of the internal heat developed on flexing, will be satisfactory for low speed and light duty (figures of 10,000 miles and 35 miles per hour have been quoted). Butyl is still new and virtually untried; improvements can be expected, but time is not available for prolonged experimentation.

Buna S, Perbunan, Thiokol, neoprene, Butyl are the present headliners in the synthetic-rubber show; certainly they are the ones most like natural rubber. Because there is no synthetic counterpart of natural rubber, whether a product is classed as a syntheic rubber depends on how one chooses to define the field. It is a matter of degree; the boundaries of synthetic rubber are not clear cut. Many other plastics are rubber-like in some respects. Because each is superior to natural rubber in some ways they will replace natural rubber for special purposes even with a cost handicap.

Clearly, synthetic rubber has long passed the dream stage, although commercial production until now has been low. About 17,000 tons were produced in 1941 (which is nonetheless about four trainloads). Of this 1500 was Thiokol; 6500, neoprene; 4000 Buna types (Ameripol, Chemigum ,etc.); and 5000 tons miscellaneous. Unlike the situation in Europe where development was spurred by heavy government subsidy, new rubbers have been developed in this country by privately financed research, and were being given the usual careful tests before large plant expansions were planned. December 7 suddenly changed the whole program.

Buna S is the synthetic rubber of greatest immediate interest to us because it has been named to carry the burden in the absence of natural rubber. In making the selection, each synthetic rubber had to be reviewed in the light of its potentialities as tire rubber, the experience of the rubber manufacturers with it, its workability on existing rubber-mill machinery, the speed with which production could start, and the availability and cost of raw materials. Laying the blue chips on Buna S does not necessarily imply that it is superior in each of these respects, but simply that, all factors considered, Buna S is the most practical synthetic rubber on which, literally, to ride through the war.

"Is synthetic rubber as good as natural rubber?" A yes or no answer cannot be given. Nor can the question, "Are tires made of synthetics as good as those of rubber?" be given a categoric answer. It must be stated: "Can as good tire tread—or tire sidewalls—or inner tubes be made from synthetic as natural rubber?" Even at this early stage it appears that the answer to each specific question is "Yes," although even the experts are reluctant to commit themselves. Obviously each part of a tire—tread, sidewalls, carcuss, and tube—has its own requirements as to stretchability, resistence to abrasion, cutting, aging, strength, porosity to air, and many other properties. There are many kinds of synthetic rubbers and each can be compounded and processed in dozens of ways, making literally hundreds in all. Each variant must be tested for a score or more of physical properties, not only by itself but in various combinations with natural rubber. There simply has not been time enough for this. Selection is further complicated by the fact that there is no "best" tire. The rubber best suited for tread on a taxi is not the best for a tire in high-speed passenger-car service, or for a truck, or a bus. Which of the multitudinous combinations is best

(Continued on Page 28)

NAMES *in the* NEWS

By WILLIAM R. SCHMITZ, Ch. E. '45
and
LEE A. SULLIVAN, M. E. '46

BILL MARENECK

After Bill had worked for two years in the industrial world, he decided that they didn't appreciate his efforts enough, so he came to Illinois to become an engineer. And he has done very well since he came as shown by the very high scholastic average of 4.96.

Bill is ward president of MIWA, member of Phalanx, T.N.T., Tau Beta Pi, Phi Eta Sigma, vice-president of Pi Tau Sigma, vice-president of A.S.M.E., and is a Cadet Captain in the Engineers. He also puts in a good deal of time on house activities, and was president of Citadel this past year.

Most of Bill's available extra time is spent working in Talbot Laboratory. He is helping with a research project on rails investigation. This last summer, Bill worked for the American Association of Railroads. He made tests on engines to determine the effects of different methods of counter-balance of the cars and engines.

Claiming Lombard, Illinois, as his home town, Bill has

BILL

thoroughly enjoyed his college career at Illinois. His chief hobby is photography, but he also likes to swim. He takes in all big dances possible, and thinks the senior ball of last spring was the most outstanding. He rates Claude Thornhill as his favorite band, and he also has a collection of popular records.

DICK HORNING

Probably one of the most active engineers here at Illinois is Dick Horning. He is a member of Ma-Wan-Da, Band of X, president of Inter-fraternity Council, vice-president of the Student Senate, member of Illini Union Board, Illini Union student activity board, fraternity advisory board, Dean of Men's council, board of directors of Y.M.C.A., and was listed in the Who's Who among students in colleges in the United States. He is also a Cadet 1st Lieutenant in the Engineer's Corps.

Dick came to Illinois from Lancaster, Pa. He said, "This is the only university I ever visited, and both my mother and dad attended Illinois." Being a general engineer, Dick is more or less following in his father's footsteps. He has spent his last three summers working at various jobs in

DICK

the engineering field. He is specializing in machine design, and hopes to go eventually into sales production.

Like a good many other engineers, Dick likes to date. He is engaged to a girl on the campus, and likes dances, movies, parties, plays, and things in general. Dick also plays the piano and his favorite musical selection is *Rhapsody in Blue*.

The biggest trouble with engineers, in Dick's opinion, is that they need to broaden themselves. They should try to learn how to get along with other people without trampling on their toes.

HILMAR CHRISTIANSON

Hilmar Christianson, better known to all his friend as Bud, is one of the most likable engineers on the campus. In fact, Bud is such an agreeable fellow that there aren't many things that he doesn't like to do. He enjoys bridge, dancing, music, poetry, chess, and sports of all kinds. He also takes an interest in photography.

Bud was the winner of the high jump at the recent intramural track and field meet. He also plays touch foot-

BUD

ball, hockey, and is quite a wrestler. Bud found time to enter the election for president of the senior class, but was defeated by the narrow margin of three votes.

A civil engineer, Bud is a member of Phalanx, T.N.T., Tau Beta Pi, Triangle Fraternity, president of Chi Epsilon, and vice-president of A.S.C.E., and a Cadet Captain in the advanced ROTC Engineers Corps. In talking about the various campus organizations, Bud says that engineers should support the things they are interested in, quoting Bud, "You should go into an organization not asking how much you can get out of it, but how much you can give to it."

During the last few summers, Bud has worked for the Milwaukee Railroad Company. He says that he would like to combine his structural engineering with architecture. A civil engineer must not only know how to design structures economically, but they must be beautiful. It is his desire to be a gentleman, farmer, and an engineer.

BOB PAXTON

The chemical engineer you see over there behind all the retorts, flasks, and test tubes is Bob Paxton. He is one of the best chemical engineers ever to graduate from Illinois. He has a very excellent scholastic average of 4.97. At the present, Bob is doing some research on the equilibrium vapor pressure of carbon tetrachloride toluene system. Unless you are also a chemical engineer you wouldn't understand what Bob is doing, so we won't bother to tell about it in detail.

BOB

Bob is very interested in music and plays baritone in the Concert band. During his high school days at Waukegan, Illinois, he won second in the national contest. Bob is engaged to a girl on campus and generally spends most of his Friday and Saturday nights with her. He especially likes to go dancing or go to a movie.

Bob is a member of Tau Beta Pi, Phi Kappa Phi, Phi Lambda Upsilon, Omega Chi Epsilon, Phi Eta Sigma, A.I.Ch.E., and Alpha Chi Sigma, chemistry professional fraternity. He plans to graduate in June and then would like to do some graduate work. Process development or administration particularly appeals to him.

The biggest thrill that Bob has received so far was when he received his invitation to pledge Tau Beta Pi during his junior year. During the past summer, Bob worked as an inspector in a factory inspecting aircraft instruments. Last year he received the Gregory scholarship and this year he has received the Phi Beta Kappa scholarship.

PAUL FREELAND

Paul Freeland is a scholar, gentleman, statesman, and soldier. He is a member of Tau Beta Pi, Phi Eta Sigma,

PAUL

Pi Tau Sigma, Military council, and is Cadet Lieutenant-Colonel of the Signal Corps. He is also helping in getting the new Honor System installed for the advanced ROTC cadets.

Hailing from Sullivan, Illinois, Paul doesn't think too much of the average co-ed here on the campus, particularly those who smoke. Whenever possible, Paul takes a week end off and runs up to Chicago to see his one and only. Paul is a quiet, dark-haired fellow and is easy to get along with.

Before the war started, Paul was a radio ham, and held a pilot's license. Since then, however, he has had to give up his airplane flying and radio operating. Paul has a low-power radio set at home on which he is able to contact every state in the United States. While he was in high school he served a term in the National Guard.

Paul is an electrical engineer and has been doing very well as shown by his good 4.65 scholastic average. He is also teaching G.E.D. I. During his spare time he enjoys playing the piano and harmonica. Paul will graduate in February and then will go to one of the Signal Corps training schools where he will be commissioned a 2nd. Lieutenant in the army. He hopes to make the service a career.

TOM CLOKE

One of the best military men to attend the University of Illinois in some time is Tom Cloke. He is Cadet Lieutenant-Colonel of the Coast Artillery, member of Scabbard and Blade, Pershing Rifles, Coast Artillery Club, Military

(Continued on Page 30)

TOM

EGGS...ON TOAST OR

Allis-Chalmers Equipment Helps Produce Food for the Nation and Bombs to Blast the Axis!

HENS' EGGS—BOMBERS' EGGS...both are needed for Victory. And both are symbols of Allis-Chalmers all-out participation in the Nation's war effort!

From Allis-Chalmers plants come more than 1,600 different capital goods products...

—Tractors and other farm equipment which help feed the U.S.A. and the United Nations!

—Mining equipment, electrical equipment, pumps, turbines, drives...the greatest variety of machinery in the world to help manufacture bombs, bullets, guns, tanks, planes, ships!

Backing up the men and women working for Victory in our plants are Allis-Chalmers engineers in the field. They are helping manufacturers produce more—not just with new machines, but with machines now on hand!

Allis-Chalmers past experience is vital to the Nation now. Its present experience will be invaluable *after* the war to help produce more and better peacetime goods for everyone!

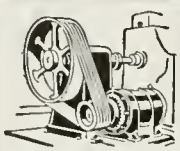
ALLIS-CHALMERS MFG. CO., MILWAUKEE, WIS.

ALLIS-CH

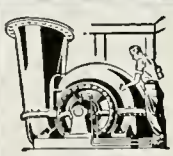
OFFERS EVERY MANUFACTURER EQUIPMENT AND ENGINEERIN

ELECTRICAL EQUIPMENT

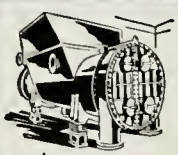
STEAM AND HYDRAULIC TURBINES



MOTORS & TEXROPE V-BELT DRIVES



BLOWERS AND COMPRESSORS



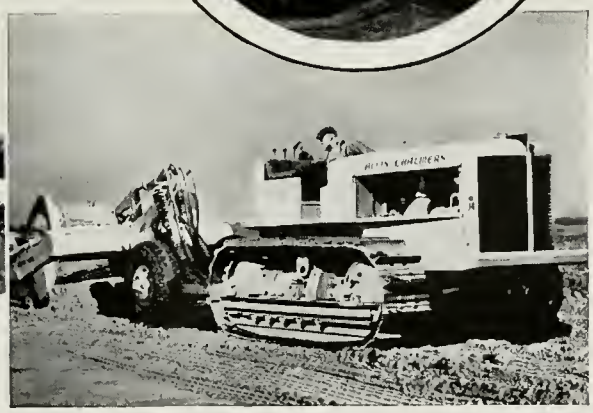
ENGINES AND CONDENSERS

CENTRIFU PUMPS

TOKYO!

A-C Equipment helps produce both steel and explosive charge for demolition bombs like the one here.

A-C Plants are casting and finishing industrial machinery at a record rate!



Chalmers tractors and grad- equipment are helping build ary roads and airports.

VICTORY NEWS

Rosiclare, Ill.—91 Allis-Chalmers motors constitute the major portion of a connected load of close to 1,000 hp driving the new fluorspar mill of the Mahoning Mining Company here.

The efficient layout of flexible motors and drives is largely responsible for the plant's record production of high-grade fluorspar zinc-lead ore. Throughout the mill, the Allis-Chalmers motors operate dump hoppers, flotation cells, vibrators, kilns, pumps and many other machines.

"We're Buying and Building," an A-C workman tells MGM bond rally starlets, as he machines a Navy propeller shaft.

Milwaukee, Wis.—The "feed-back" system, which utilizes 85% of the enormous power expended in breaking in aircraft engines on test stands, has been adopted by Buick in its new plant in a mid-western city.

The new engines are connected by flexible shaft couplings to water-cooled magnetic couplings, which transmit power to 1200 kva synchronous generators.

Allis-Chalmers alternating current units are at work here. They not only help to crank the new engines, but they also operate as current absorption-type dynamometers—receiving power from the aircraft engine, turning it into electrical energy and feeding it back into the line. This test set-up provides a high percentage of the power required by this company's manufacturing operations.

FOR VICTORY
Buy United States War Bonds

ALMERS

WE WORK FOR VICTORY — WE PLAN FOR PEACE

ATION TO HELP INCREASE PRODUCTION IN THESE FIELDS...

R AND SAW EQUIPMENT

CHEMICAL PROCESS EQUIPMENT

CRUSHING, CEMENT & MINING MACHINERY

BOILER FEED WATER SERVICE

POWER FARMING MACHINERY

INDUSTRIAL TRACTORS & ROAD MACHINERY

Our Societies . . .

By BYRON M. ROBINSON, M. E. '44

SIGMA TAU

Sigma Tau held its fall initiation and dinner at the Inman Hotel, on November 29. "Railroads in the War" was the very timely subject of Prof. H. J. Schrader, speaker for the evening.

Sigma Tau's annual award for excellence in scholarship during a student's freshman year was presented to Philip M. Dadant, E.E. The names of the newly initiated members are as follow: Raymond Ackerman, George Beck, Eugene Bierman, Pete Fenoglio, Evan Greanias, Lowell Lambert, Sheldon Leavitt, Gordon McClure, James Meek, Arthur Radke, George Roller, Harold Schick, Nathan Schwartz, Robert Settle, Robert Turner, Harold Wandling, and Homer Wong.

CHI EPSILON

Chi Epsilon held an initiation and banquet on November 18, at Latzer Hall, Y.M.C.A. Dr. Moore of the T. & A. M. Dept. gave a most interesting speech entitled "Is the Engineer Cultured?" His answer being that the engineer is cultured—he has a culture all his own. Pi Tau Sigma was a co-sponsor for the banquet.

PI TAU SIGMA

On November 18, seventeen new members were initiated into Pi Tau Sigma. The names of the new initiates are as follows: H. H. Aiken, C. C. Arnold, K. N. Drager, G. G. Greanis, J. W. Huff, P. Kohler, R. E. Kraft, D. J. Lattyak, J. J. Luza, R. G. Moldt, D. E. Muni, W. J. North, B. W. Porter, C. J. Roach, R. G. Settle, V. K. Viitanen, and W. J. Worley. Following the initiation, a banquet was held in Latzer Hall, Y.M.C.A., with Chi Epsilon as co-sponsor.

A Mark's Hand Book was awarded at a banquet held at the Inman Hotel on December 6. The recipient was Harold E. Secrest, sophomore, who had the highest grade average among freshmen M.E.'s last year. This is an annual award given by Pi Tau Sigma.

A.S.A.E.

At their last meeting on October 27, the Ag Engineers were privileged to hear Prof. P. E. Johnston. He spoke on the subject "Farm Labor and Machinery and the War." (The farm machinery situation should be good as long as baling wire is available.)

A.S.A.E. lost one of its most active members in Murray Forth. He was secretary of the A.S.A.E. before he was drafted.

TAU BETA PI

The semi-annual initiation of Tau Beta Pi was held November 28, 1942 on the third floor of the Illini Union. The following men were initiated: First semester junior honor man—George Roller, Ch.E; Seniors—M. C. Shedd, Arch.E.; O. E. Johnson, Agr.E.; Tom Baron, J. L. Erickson, N. W. Myers, and R. C. St. John Ch.E's; D. S. Bechly, H. B. Christianson, Sidney Epstein, C. E. Kesler, A. F. Kohnert, Jr., and O. W. Schact, Jr., C.E.'s; P. A. Freeland and S. D. Larks, E.E.'s; G. D. Schott, E.P.; W. A. Lindahl, G.E.; W. J. Gailus, G. G. Greanias, G. M. Long, G. E. Mays, Clarence Ritchard, O. R. Schmidt, R. G. Settle, O. M. Sidebottom, and Steven Yurenka, M.E.'s. A certificate of merit was awarded to Miss Marianna Schroeder for her outstanding achievement in Architectural Engineering.

Following the initiation, a banquet was held, faculty members, actives, and new initiates of Tau Beta Pi being present. Prof. J. J. Doland was the toastmaster, and Prof. H. E. Murphy was the principal speaker of the evening. After the banquet, the annual Tau Beta Pi dance was held.

A.S.M.E.

Every year, the A.S.M.E. presents the Charles T. Main Award of $150, and an engraved certificate for the best paper submitted on the subject selected by the Board of Honors and Awards. The subject for 1943 is "Government as Affected by Engineering."

Two awards of twenty-five dollars each will be given for the best papers on any engineering subject or investigation written by a member of the student branch at this university—one award for a graduate student—one award for an undergraduate.

This competition is restricted to student members of the A.S.M.E. The awards will be given for the best papers, judged from the standpoint of applicability, value as a contribution to mechanical engineering literature, completeness, and conciseness. For further information, see Paul Salerno, or Prof. P. E. Mohn in 104 M. E. Lab.

S.B.A.C.S.

It was on the night of December 10, that the annual Ceramic Department pig roast was held at the Y.M.C.A. The Seniors really roasted the faculty, but then the professors were not lacking for choice bits of interesting dirt, either. Coach Hek Kenney gave a demonstration of rough and tumble fighting.

On the pig roast committee were Ray Davies, in charge of arrangements, and Eugene Lynch, in charge of favors. The favors were little white porcelain pigs shaped so that they could be used either as cigarette trays or cream pitchers. These useful articles were made by the ceramic students.

KERAMOS

The members of Keramos indulged in the Ceramic Department pig roast on December 10. Plans for the Keramos Senior Banquet to be held in January, are not yet complete.

M.I.S.

At the November 11 meeting of M.I.S., Mr. G. W. Bruce, Assistant Superintendent of Open Hearth No. 2 at Carnegie Illinois Steel Company South Works in Chicago, spoke on general plant practice. The main purpose of his speech was to show the practical side of production in the steel mill.

On December 3, three very interesting sound films were presented to M.I.S. by the Aluminum Company of America. The films shown were *Aluminum—Mine to Metal*, *Aluminum Fabricating Processes*, and *Unfinished Rainbows;* the latter being a Kodachrome film of the history of aluminum from its beginnings, the discovery of the electrolytic process, and the progress aluminum has made since then, and its possibilities in the future, which prompted the title of the movie.

(Continued on Page 24)

COMMUNICATIONS
...directing arm of combat

This battle drawing was prepared with the aid of Army and Navy authorities.

IN modern battle, our fighting units may be many miles apart. Yet every unit, every movement, is closely knit into the whole scheme of combat—through communications.

Today much of this equipment is made by Western Electric, for 60 years manufacturer for the Bell System.

Here are some examples of communications in action.

1 Field H.Q. guides the action through field telephones, teletypewriters, switchboards, wire, cable, radio. Back of it is G. H. Q., directing the larger strategy... also through electrical communications. The Signal Corps supplies and maintains all of this equipment.

2 Air commander radios his squadron to bomb enemy beyond river.

3 On these transports, the command rings out over battle announcing system, "Away landing force!"

4 Swift PT boats get orders flashed by radio to torpedo enemy cruiser.

5 From observation post goes the telephone message to artillery, "Last of enemy tanks about to withdraw across bridge..."

6 Artillery officer telephones in reply, "Battery will lay a 5 minute concentration on bridge."

7 Tanks, followed by troops in personnel carriers, speed toward right on a wide end-run to flank the enemy. They get their orders and keep in contact—by radio.

Western Electric
ARSENAL OF COMMUNICATIONS

TECHNOCRACKED . . .

By PAUL SALERNO, M. E. '43

A chemical genius south of Green Street has completed an exhaustive study of an element that has long puzzled the greatest scientific minds.

ELEMENT: Woman.

SYMBOL: Wo.

ATOMIC WEIGHT: About 120.

OCCURRENCE: Can be found wherever man exists—always appears in a disguised condition—surface usually covered by a film of powder—boils at nothing and may freeze at any moment.

CHEMICAL PROPERTIES: Extremely active — possesses a great affinity for gold, silver, platinum, and precious stones of all kinds — able to absorb tremendous quantities of expensive food at any time — undissolved by liquids, but activity is greatly increased when saturated with alcohol — turns green when placed next to a better sample — ages rapidly — very dangerous and highly explosive in inexperienced hands.

* * * * *

Maybe you've heard this story about the draft dodger who said, "What chart?" to the army doctor. After being deferred because of near blindness, he went to a movie to celebrate. Imagine his dismay when he saw that the same doctor who examined him was sitting in the next seat. Thinking fast, he reached over and tapped the doctor on the shoulder.

"Pardon me," he asked politely, "Is this where I catch the bus to Chicago?"

* * * * *

Skidding is the action,
When the friction is a fraction,
Of the vertical reaction,
Which results in traction.

* * * * *

First small boy: "See that little girl over there? Her neck's dirty."

Second small boy: "Her does?"

* * * * *

HE: "Are you free tonight?"

SHE: "Well, not exactly free, but very inexpensive."

The latest addition to the women's auxiliary services such as the WAVES and WAACs, are the WORMS.

They're in the Apple Corp.

* * * * *

Two pigeons were flying over Tokyo.
"Say, isn't that Hirohito down there."
"I think it is."
"Well, what are we waiting for?"

* * * * *

ODE TO A SCREWBALL

You try to be clever
And what do you get?
You're marked down forever
As strictly all wet.

You try to be witty
And what's the reward?
A few laughs or pity
In some minor chord.

You try to be humorous
But strive as you may,
The slams will be numerous
And they'll all come your way.

The moral is clear
If your life would be sunny
Don't try to be FUNNY!!!

* * * * *

A rookie paratrooper was receiving orders from his commanding officer just before his first jump.

"Remember," he was told, "your chute will open as soon as you leave the plane. If it doesn't, pull this emergency rip-cord. It will always work. A jeep will be waiting for you when you land. That is all."

The soldier jumped. Nothing happened. He pulled the emergency rip-cord. Still nothing happened.

"Damn," he muttered, "I'll bet that jeep won't be there either."

* * * * *

Wife: Did you see those men stare at that pretty girl as she went up the stairs.

Husband: What men?

What kind of Future should a man prepare for?

One thing is certain: The future is going to be very different.

Now, as you finish your training, many of you with your war participation fully determined, the future of peacetime seems very remote.

It *is* a bridge we're all going to have to cross when we come to it. Nobody knows exactly what it will look like. But we do know that what lies on the other side will be largely what all of us together make it.

Even now, responsible men in industry are thinking how to make jobs for the men coming back from the services, and for the men now in war applications. It will be done by dreaming up new things to make, and new ways to make old things better.

This is being done by a combination of imagination and engineering, industry by industry. Here at Alcoa Aluminum we call it Imagineering. It is the thing that made our company the leader in its industry—that got aluminum ready to do the great job it is doing in this war. All our people practice Imagineering, as second nature, whether they are called engineers, or salesmen, or production men, or research men.

The future isn't going to be made out of laws, or pacts, or political shibboleths. The only kind of future worth having will come out of freedom to produce, and out of the *Imagineering* of men who make the things that civilization rests on.

If we could go back to college again, we would get ready to be an Imagineer, in whatever particular field our interests lay. The opportunity for young men with imagination is going to be unparalleled.

A PARENTHETICAL ASIDE: FROM THE AUTOBIOGRAPHY OF

ALCOA ALUMINUM

• This message is printed by Aluminum Company of America to help people to understand *what we do* and *what sort of men* make aluminum grow in usefulness.

Report on the A. S. C. E. Conference

By WILLIAM G. MURPHY, C. E. '43

The Second Annual Midwestern Conference of the Student Chapters of the American Society of Civil Engineers was held at the University of Illinois on November 13 and 14 in spite of gas rationing, rubber rationing, and transportation difficulties. The decision to have a conference this year came after the Executive Council had considered every angle and it was recommended that the conference be used as a means to direct the students minds toward engineering and the war effort.

Iowa State College, Illinois Institute of Technology, Northwestern, Illinois, Purdue, Rose Polytechnic Institute, University of Wisconsin, and the University of Iowa were represented at the conference. The delegate who received the most attention was the girl who attended from Iowa State.

The conference was directed by Sterling Snyder who was assisted by three co-ordinators: Marianna Schroeder, William Murphy, and Bud Christianson. The co-ordinators were responsible for the work of the committees who made the arrangements for the meeting.

The Conference opened with a welcoming address by Dean M. L. Enger, a talk by Dean H. H. Jordan on "What This Conference Should Accomplish," and a talk by Professor W. C. Huntington on "The Chapter and The Department." Dean Enger cranked the conference bandwagon, Dean Jordan put in the right fuel—profession solidarity, objects and ethics of the society, and the preamble of the Constitution of the Conference, and Professor Huntington got the program off to a fine start with his talk.

The afternoon of November 13 was saved for Structural Engineering in Defense with talks on "Timber Construction" and "Fatigue of Welded and Riveted Joints" by Mr. J. F. Seiler and Professor W. M. Wilson, respectively. Mr. Seiler of the American Wood Preservers Association emphasized the importance of timber due to the priorities on metal, and told how the Armed Services are using composite construction to preserve the metal. The first talk was concluded by slides showing various uses and processes in timber construction.

Professor W. M. Wilson, research professor in Structural Engineering, spoke on the results of his research on the fatigue strength of riveted and welded structural members. One of the most difficult problems of the investigation was the design of a machine to use in the project. Professor Wilson's talk centered on the highlights of his work for the last six years.

Saturday, November 14, was set aside by the program committee for Sanitary Engineering in Defense with addresses by Mr. William Wisely, Executive Secretary of the Federation of Sewage Works Association, a worldwide organization; and Mr. C. W. Klassen, Chief Engineer of the Illinois Public Health Department.

Mr. Wisely spoke of some of the experiences that he had had in the field of Sanitary Engineering. Some of his talks appeared humorous to the audience but they were very real problems in dealing with people that a sanitary engineer must face. In his conclusion Mr. Wisely stated that Sanitary Engineering is a profession that: brings cleanliness into this civilization, helps cities abide by the Golden Rule to meet moral as well as legal obligations, and conserves not destroys the natural resources loaned for use.

Mr. Klassan spoke on the "Plans for Supplying Sanitary Engineers in War Time." The demand greatly exceeds the supply according to the speaker and the requirements and age limits are going to have to be cut in order to obtain the number that will be needed for the progress of the war. Mr. Klassan illustrated his talk with slides of disasters in Illinois.

The afternoon session of November 14, consisted of two speeches: Dean M. L. Enger on "Airports" and Mr. Fullenwider of the State Highway Department on "The Effect of the War on Highways."

According to Dean Enger the war has accelerated the development of air transportation and the post war era will see a very rapid change in the transportation of freight and passengers. Many engineers and scientists will be needed to design the necessary airports to carry all the traffic that is anticipated.

Mr. Fullenwider told the assembly that the only roads being built in the state at this time are the necessary trunk lines for military transportation. There is, however, a great deal of maintenance work being done to preserve the existing system until after the war. Priorities are causing the big problem in the field today. Recently specification for highway bridges made a transition from all steel construction to one of timber with steel connectors.

The members of the local chapter made every effort to impress the visitors with the excellence of the engineering department here. How well they succeeded can be shown by a story told by the president of the conference. He told of a dream where he had gone to Heaven and while on a tour of his new residence with Saint Peter he learned that all the people of the various professions live in separate communities according to their profession here. Suddenly his guide directed him to remain quiet while going through a village and to ask no questions. After passing the village and being unable to control himself any longer he asked Saint Peter what that last place was. Saint Peter answered, "Those are the boys from Illinois, they think there isn't anyone else up here."

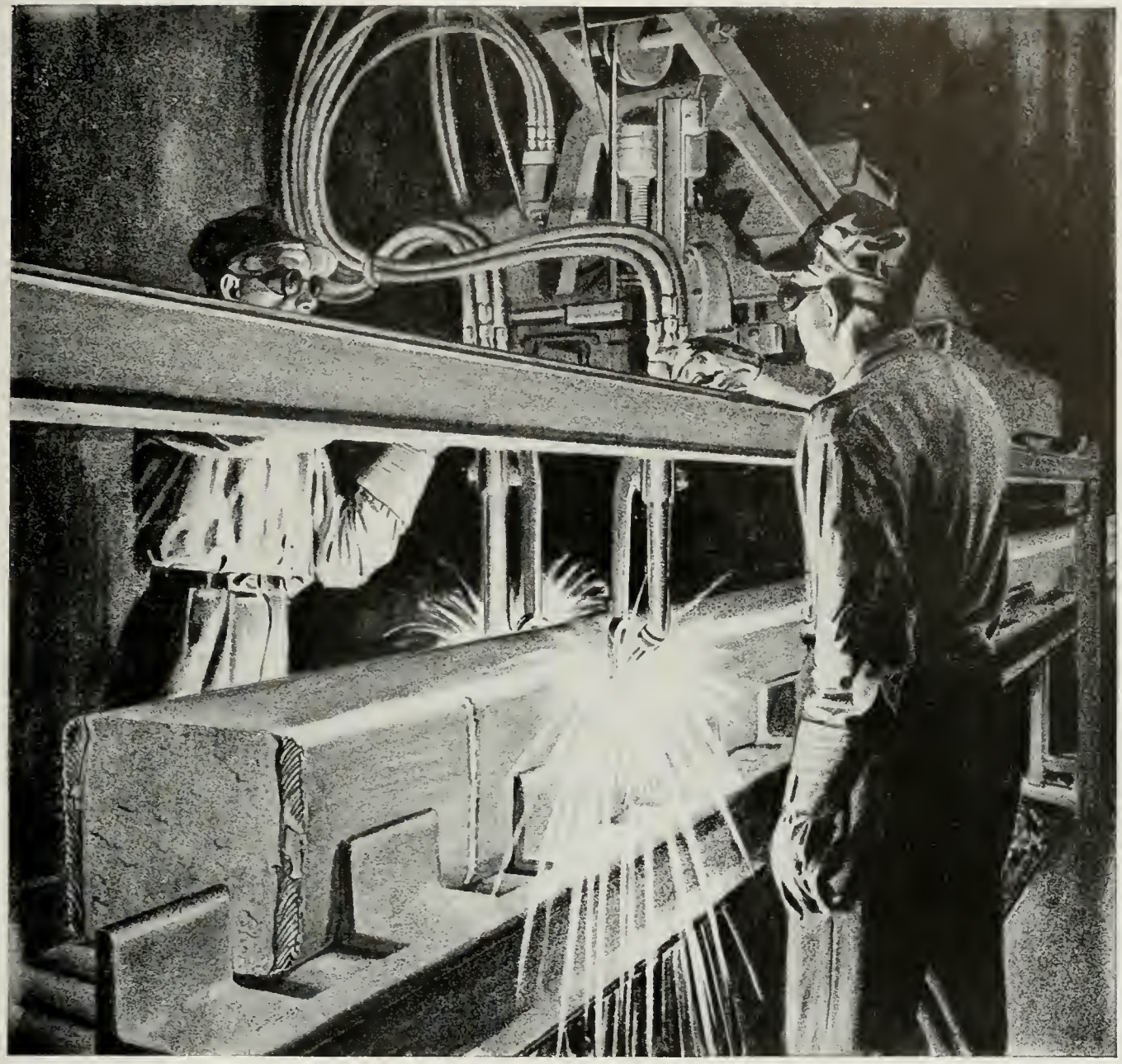
Engineers—It's

Charlie's Restaurant

GOOD FOOD
QUICK SERVICE

★

202½ S. Mathews — Urbana



BILLETS TO BULLETS FASTER!

BY reducing billets to slugs faster, this recently perfected Airco machine gas cutting application speeds shell production. The Airco cutting torches — as many as ten can be mounted in this new Billet Nicking Machine — make simultaneous cuts a fraction of an inch into a billet, at a speed of from 20" to 30" per minute. After nicking, a sudden blow produces a clean break.

This new Airco developed cutting application reflects the ability of Air Reduction's Research and Development Engineers to quickly fulfill new industrial needs. Thus, Air Reduction customers are first to benefit from many oxyacetylene applications now speeding war production.

Even as they have revolutionized all-out war production, so in the peace to come these processes will show the way to better products, machines and structures at less cost.

To better acquaint you with the many things that this modern production tool does better we have published "Airco in the News", a pictorial review in book form. Write for a copy.

AIR REDUCTION

General Offices:

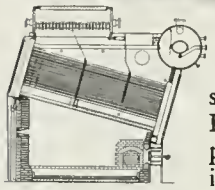
60 EAST 42nd STREET, NEW YORK, N.Y.

In Texas:

Magnolia-Airco Gas Products Co.
General Offices: HOUSTON, TEXAS
OFFICES IN ALL PRINCIPAL CITIES

ANYTHING AND EVERYTHING FOR GAS WELDING OR CUTTING AND ARC WELDING

B&W boilers power Liberty ships



The Liberty Ship program is the biggest shipbuilding project in history and every Liberty Ship that goes into commission is powered by B&W-designed boilers. B&W is now building many of these boilers; other manufacturers, working to B&W designs, are producing the remainder.

Thus the skills and knowledge gained by B&W during peace-time leadership in boiler manufacturing are now contributed to the war-time needs of the nation. When Victory is won, B&W will be able, better than ever before, to supply those of you who enter the power industry with superior steam generating equipment.

The Maritime Victory flag and 'M' burgee now float proudly alongside the Navy 'E' at the Barberton Works. Each is an award for "outstanding achievement" and is "an honor not lightly bestowed".

THE BABCOCK & WILCOX COMPANY • 85 LIBERTY STREET • NEW YORK, N. Y.

BABCOCK & WILCOX

TAU NU TAU

(Continued from Page 18)

On December 8, the Bofors 40mm anti-aircraft gun was demonstrated. The gun's various accomplishments were enumerated, and its mechanism was thoroughly explained.

The annual T.N.T. dance will be held January 9, 1943 in the Illini Union. This dance will be sponsored jointly by T.N.T. and C.A.C., and will be uniformal. There are to be no corsages of any sort for the dance.

The final meeting of T.N.T. for the semester will be January 12, 1943, with election of officers for the coming year.

NEW ANTI-AIRCRAFT GUN

Workmen, men and women alike, wear a bronze button with an E on it around a certain Pontiac plant somewhere in Michigan. Henry Klingler, the head of the company wears one of these little bronze E buttons, too. He's proud of it and is working hard, and overtime for the right to wear it, for the right to fly that beautiful E pennant from the flag staff of the factory. For that Navy E means "excellence," and denotes that this factory and these workmen are doing a great job for their navy. The job they're actually doing is helping to keep the deadly enemy dive bombers flying high, keeping them from effective bombing, and shooting them out of the sky if they dare it. For Pontiac has made a record manufacturing the famous Oerlikon 20 millimeter (that's a little better than a half inch) antiaircraft cannon. This Oerlikon shoots like a garden hose, spraying 450 shells a minute. That's almost eight shells a second. And you just lay back in a cradle and sight it like a shotgun or a garden hose. Eight deadly half-inch shells a second, in one-two-three order. First an explosive shell, then an armor piercing, and the third a tracer. You can see how you're shooting with that dotted line of tracer shells splitting the sky.

Now a dive bomber is well in the range of fire from an Oerlikon cannon for 17 seconds. That means that a gunner can get in more than 100 shots — allowing for a change of shell holder — during the time the dive bomber is well in the range of his fire. And no bomber can take that kind of rough treatment. Even a single explosive shell through a wing would knock it off its flying course and spoil its bomb aim.

It's a marvelous little gun with quite a romantic history. A German inventor sold his patent to a Swiss gun maker who named the weapon after the little Swiss town of Oerlikon, where the gun was made. At the fall of France, a certain British naval commander assigned as an inspector at the plant, grabbed up the plans and flew them out via Roumania. From England the plans reached us.

Now it took the Swiss armament maker eleven and one-half months to get this gun into production. In England it took an armament firm nine and one-half months to start turning out the gun. But Pontiac, without any previous experience in armament making, got into production in exactly seven months, including getting the subcontractors going.

But the swiftly moving American efficiency didn't stop with getting into production. All along the line, time schedules were speeded up. It was an entirely new and different method that American mass-production genius pioneered here. It was a case of transforming "the whittle and yodle school of Swiss manufacturing," where there was plenty of time, to the quick, vibrant, highly efficient speed-up of American industry. In the old methods, breech-block castings weighing around 170 pounds, had to be bored, worked, filed, and babied by hand. Today 240 separate operations are performed by machines. And when the job is over, that 170-pound casting comes out a beautiful breech-block, weighing exactly 41 pounds.

When the government gave out the order, 10 fine machines for boring gun barrels lay boxed on the docks in New York, ready for shipment to France. Henry Klingler grabbed these and set them up in his plant. Each machine could bore out a solid gun barrel in two hours and 16 minutes. That was pretty fast. But the brand new boring machines today do a gun barrel in six minutes; and the ten old machines have been replaced by two special outfits, that don't even work all the time at that.

Now from the "whittle and yodle" European school of manufacturing, to the mass production of the transformed and transmigrated American motor industry, is a leap from the past to the future. This beautiful Oerlikon killer of enemy dive bombers, and protector of American ships and American sailors, is like a Swiss watch. Yet it is now being made even more accurately under super-modern American mass-production methods.

From one end of America to the other, this miracle of the "change-over" is going on. You don't turn a faucet or a crank, and have tanks or bombers or fast-firing cannon roll off the same assembly lines that once turned out our automobiles or tires or sewing machines. Most of the old machines of industry must be scrapped and shoved aside and special new machines built — new jigs, dyes, tools of every kind. It's been a hard, slow and often discouraging job. But America has done it, and the world has never seen such a flow of war goods as this very day are pouring from thousands of factories and plants.

Within a very few months we will reach our peak production. But there is no moment to lose. Destiny does not wait for her appointments. And we do have "a rendezvous with Destiny." Let's keep it.

New Multicircuit Switch for Aircraft Service

A new multicircuit switch which opens, closes, or transfers as many as 20 circuits simultaneously by means of a two-position operating knob, has been announced by the General Electric Company for aircraft service.

The contact mechanisms used are G-E switchettes stacked in pairs. The switchette is snap action, doublebreak in construction, giving it a high current rating. The switch is available with from 8 to 20 switchettes, and in either single-circuit or two-circuit form. A shaft toggle switch insures positive switch position.

The multicircuit switch meets specifications set up by the U. S. Army Air Forces for devices of this type. Weight varies from 5⅓ ounces to 10⅔ ounces, depending upon the size selected.

New Relay in Line of Aircraft Control Devices

A new four-pole relay, designated CR2791-GLOOK, has been added to the line of General Electric control devices for aircraft applications. Features of the new relay are lightweight, permanence of contact position and assurance of operation under severe vibration conditions, and operation at high altitudes at rated current.

The relay has a maximum continuous current rating of 10 amperes at 12 or 24 volts d.c., and a maximum make

LIST OF PRODUCTS . . . Alloy and Carbon Steel Billets: Seamless Steel Cylinders, Liquefiers, Pipe Couplings and Pump Liners: Hollow and Drop Forgings: Pipe Flange: Coils and Bends.

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or break current rating of 50 amperes at 12 or 24 volts d.c. The normally open contacts have a tip travel of 3/64. Coil wattage is 1.80. The relay weighs .281 pound.

Dimensions are: length, 2½ in.; width, 1 5/32 in.; and height, 1 25/32 in.

NEW SMALL MOTOR FOR AIRCRAFT SERVICE

A new small fractional-horsepower frame motor for aircraft service has been added to the line of General Electric motors for specific aircraft applications. The motor, designated BA-10, is designed for use with control and protective devices.

The BA-10 motor weighs only eight ounces, is 3 9/16 in. long, 1⅜ in. in diameter, and includes a gear reduction to a speed of approximately 125 rpm. The motor is also available without gears, or with additional lightweight gears to give an output speed as low as 1 to 2 rpm.

TINY LIMIT SWITCH FOR AIRCRAFT SERVICE

A new lightweight limit switch designed especially for aircraft applications has been introduced by the General Electric Company.

The contact mechanism used is the G-E switchette. Snap action and double-break operation give the switch a high current rating. The switch is designed to meet all U. S. Army Air Forces stipulations. The plunger operates with a 7/32 in. overtravel, which increases the number of applications for which the switch can be used.

The aluminum housing is made dustproof by the use of a gasketed cover. There is adequate space inside the housing for easy wiring. The switch is available in three contact arrangements: single-circuit, normally open or normally closed; and single-pole, double-throw.

Each form can be furnished with a contact air gap of .010, .020, or .030 in. The switch weighs .13 lb.

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AIR TRANSPORTATION

(Continued from Page 7)

and grades, for permissible heights of obstructions in the vicinity of the field, for field lighting, radio and other facilities. It is recommended that no field be selected which cannot be enlarged to a square mile if future traffic should demand. Light planes can take off and land safely on sod runways 1800 feet long, but heavy transports require paved runways 4500, or more, feet in length. Future developments in the airplane may make shorter runways possible, but the present trend is to large, fast planes which may require even greater runway lengths.

Engineers and scientists will be needed for the design, construction, and operation of airports, flight strips, and airways, and for the design and manufacture of engines, propellers, airplanes, instruments, and other equipment, and for research and development. The business operations of air lines will require accountants, lawyers, and other graduates. In order that the University may provide education and research in air transportation it is recommended that a Class 3 airport be constructed near the campus. Such an airport would require 640 acres of land, three paved runways each 4000 feet long and 150 feet wide, field lighting, hangars, shop, laboratory, and an administration building.

TRIM TAB FOR AIRPLANES WINS

Top award in the Transport Group of the Fifth Annual Modern Plastics Competition sponsored by Modern Plastics Magazine goes to the Glenn L. Martin Company, Baltimore, Md. for laminated plastic airplane trim tabs developed in conjunction with the Formica Insulation Company, Cincinnati, Ohio, and the Taylor Fibre Company, Norristown, Pa.

The trim tabs developed by each of the collaborating companies differ in size and detailed design and apply to different airplanes. The basic purpose of the trim tabs is to relieve the pilot of unnecessary forces on the normal flight controls. The tabs are adjustable from the cockpit and by varying their setting, relative to the surfaces to which they attach, the pilot is able to balance the airplane for various conditions of flight, such as, cruising, climbing, or gliding. The controls leading to these tabs are nonreversing in character and therefore the settings are continuously maintained until the pilot desires to change them. If it were not for the trim tabs, the pilot would have to hold the airplane in the desired condition of flight by continuously exerting appreciable forces on the control column and rubber pedals, and this would soon become very tiring.

Designed for use on ailerons, elevators, and rudders, these plastic tabs are to be used in place of metal or fabric parts and combine valuable features of lightness and strength. The laminated phenolic fabric base structure weighs appreciably less than aluminum and on strength tests has far exceeded specifications established for metallic tabs. The resiliency of the laminated structure causes the tab to keep its shape under stress where metal parts are often permanently distorted. The smooth uninterrupted surface of the plastic tab offers many advantages over a metal tab having projecting rivet heads or overlapping seams. Moisture does not affect the material and it is not subject to corrosion.

The flat longitudinal strengthening bulkhead inside the tab increases very greatly the rigidity of the exterior surfaces. This bulkhead also provides an ideal attachment and supporting surface for the hinges, control horns and other similar parts. The interior bulkhead is made integral with the exterior part of the tab so that a homogeneous structure of great strength is produced.

(Continued on Page 30)

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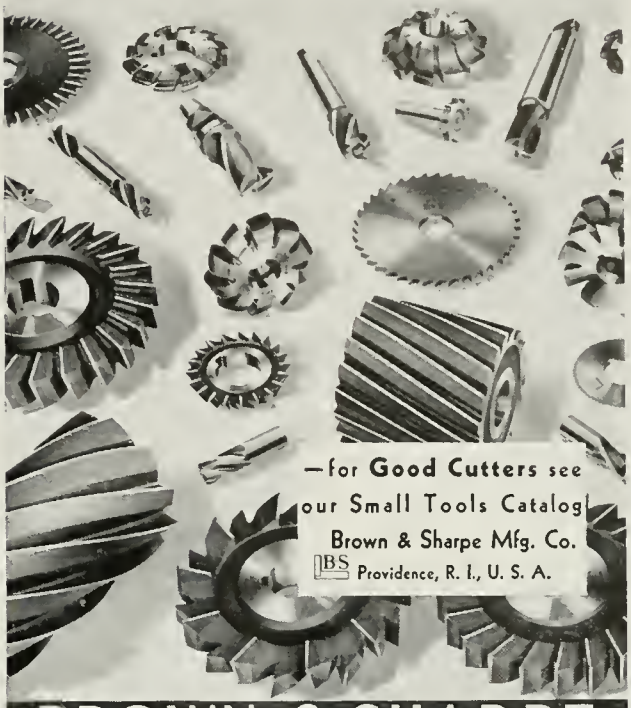

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Synthetic Rubber — New Major Industry

(Continued from Page 13)

could be and will be determined by extensive experience. However, the situation at present is controlled by the necessity for an adequate solution quickly, not in achieving the ideal. Even so it is likely that inner tubes, tire carcass, sidewalls, and tread will be made of different synthetic rubbers, either alone or in combination with natural rubber. Furthermore, this practice probably will continue even when plantation rubber becomes available again because a superior tire will result from making best use of the advantages of both natural rubber and each of the synthetics.

As to elasticity and rebound, natural rubber is still king. The stretchability of some synthetics closely approaches, at certain temperatures, that of natural rubber, but none are quite as good under all conditions. Natural rubber is also superior in a few other important respects. It is softer than synthetic rubber, and hence is easier to process or work in rubber mills. Rubber is more resilient than nearly all of the synthetics. This means it has low energy absorption, or hysteresis, and consequently does not build up temperature on repeated compression and extension. Low energy absorption is not always an advantage, however. For vibration absorption, as for engine mountings, this quality of natural rubber may be a distinct disadvantage. Lastly, rubber is more resistant to stiffening at low temperatures than most synthetic rubbers, but improvement of synthetic rubbers in this respect can be expected.

Natural rubber, properly compounded with carbon black, has good tensile strength, generally given as from 2400 to 4500 pounds per square inch. Some synthetic rubbers equal it, but none are markedly better at normal temperatures. However, synthetic rubber, almost without exception, retain their initial strengths under conditions of sunlight, ozone, chemicals, heat, etc., far better than does rubber.

Abrasion resistance is of particular importance in tires. In this respect several synthetics are as good, and Buna S and Perbunan are appreciably better than natural rubber.

It is in resistance to sunlight, ozone, chemicals, oils, etc., that the real superiorities of synthetic rubber appear. Thiokol, neoprene, Perbunan, Koroseal, and others are highly oil resistant and have already largely replaced natural rubber in hose for oils and gasolines. They are also used in printing rolls and engraving plates. Koroseal makes superior seals, gaskets, and diaphragms for oil pumps. Oil-resisting gloves are made of neoprene. Thiokol, neoprene ,and Koroseal are outstandingly resistant to sunlight and ozone, both of which shorten the life of natural rubber. They are accordingly used in many airplane parts such as de-icers, which are subject to direct sunlight. Gas-cell fabrics of balloons and airships are coated with neoprene and Thiokol, which, in addition to their resistance to sunlight, are far less permeable to gases than is natural rubber. Some synthetics are as much as 25 times more impervious to gases than rubber, so that inner tubes made of them would hold air indefinitely. Synthetics, neoprene and Koroseal in particular, are being adapted extensively for insulated wire. This is not because of electrical superiority, as some are slightly inferior, but because of their better resistance to burning and to deterioration by ozone. The dielectric constant of the Buna rubbers, except Perbunan, is about the same of slightly lower than natural rubber, but the others are higher. The power factor of Vistanex is lower than for rubber; Buna S about the same; and Thiokol and neoprene, higher. The conductivities of all synthetics, except Vistanex and Koroseal, have higher dielectric strengths than natural rubber, while the strengths of Thiokol and neoprene are slightly less.

The point is, rubber is an engineering material having many properties; not elasticity alone. In synthetics we have a group of materials of specialized, superior properties, that can compete with tree-grown rubber for many uses. They were beginning to do so before the war, even with a three- or four-to-one price handicap. To what extent they will continue to supplant natural rubber when free trade is resumed depends on (a) the cost of plantation rubber, (b) the costs of synthetics when produced on a high-production basis with a background of technical experience and (c) the improvements that will undoubtedly be made in synthetic rubber.

Tremendous amounts of steam are required in the various processes involved in the manufacture of raw materials—butaduene and styrene—for Buna S rubber. In fact, the steam for a single 50,000-ton annual capacity butadiene plant, if supplied at about 800 pounds to non-condensing power turbines exhausting at 150 pounds, will produce about 40,000 kw in electrical energy, only about one-half of which is required by the electrical equipment in the plant.

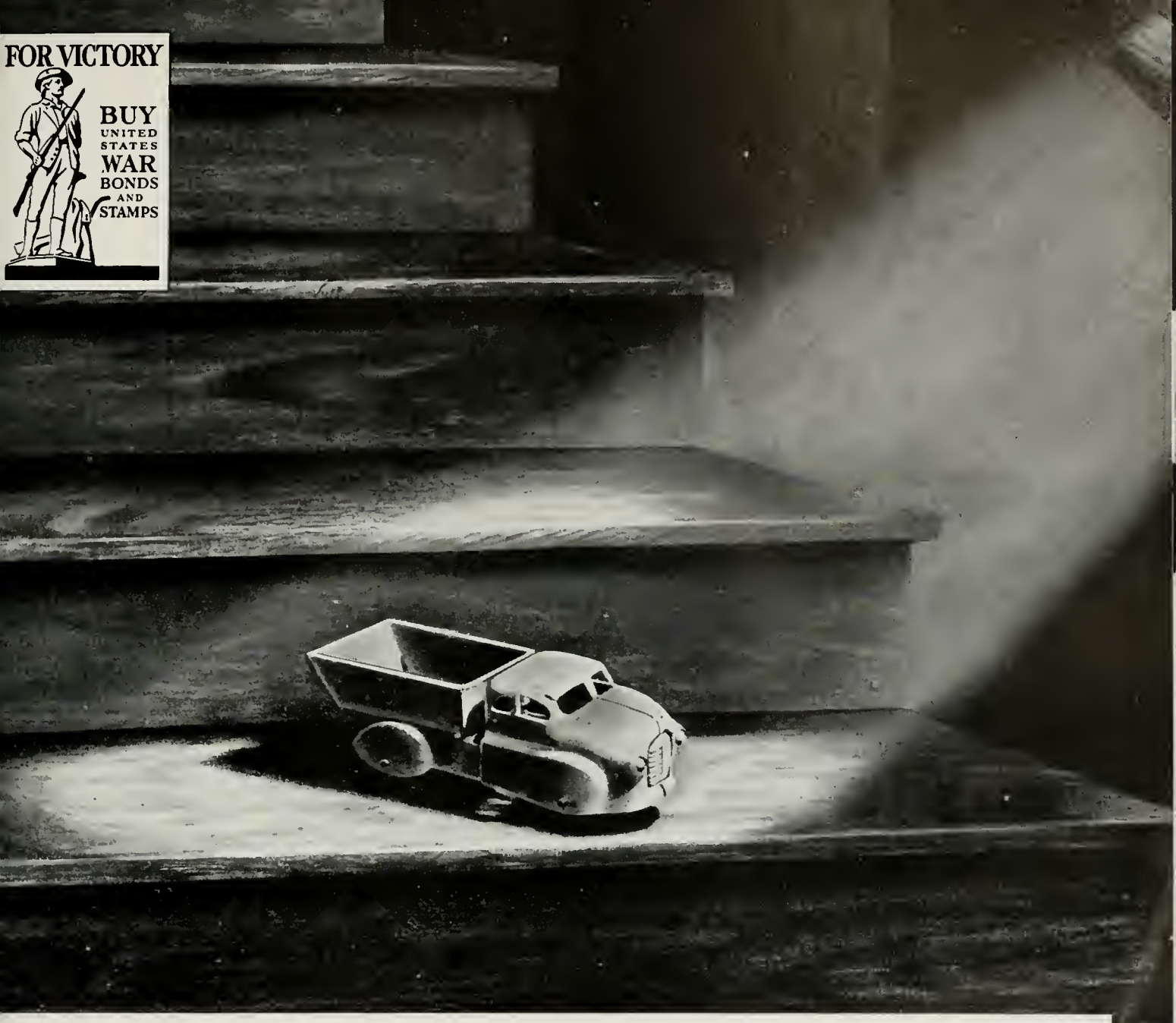
The synthetic rubber plants are installing turbo-generators to recover this by-product power. These turbo-generators are tied in with existing utility systems, providing a back-up service to give to the operation of the synthetic rubber plant a maximum of reliability.

The main turbines in these butadiene and styrene plants will receive steam from 750- to 800-pound boilers. They will exhaust at from 150 to 190 pounds for process requirements and to mechanical-drive turbines, which in turn provide 15-pound process steam. Steam will also be bled from these electric-power turbines at 450 pounds, which may be supplemented by steam from 450-pound boilers, to supply mechanical-drive turbines and high-pressure boilers, high-pressure power-generation bleeder turbines, and mechanical-drive turbines give a flexible system by which efficient heat balances can be maintained for all the process work.

The rubber mills in which the raw synthetic rubber will be processed into finished articles will not require fundamental changes in electrical equipment. Because synthetic rubber is stiffer than natural rubber, the rubber-working machinery will require more horsepower per ton produced.

The rubber industry is old and well established. Great improvements have been made in processing natural rubber, as those who drove a car 25 years ago can testify. Synthetic rubber is new. Much remains to be learned about the best methods of handling and compounding the types already known, and new types will undoubtedly be discovered. The possibilities are almost limitless; already over 6000 co-polymers with butadiene have been tried. New synthetic rubber, improved synthetic rubbers are sure to appear.

Come the peace and whatever will then constitute normal times, the engineer will have at his command a large family of rubber-like materials, each with its special merits, which can be used along with natural rubber to produce better tires, tubes, belts, gloves, hose, vibration absorbers, electric insulation, and literally thousands of other necessities. The synthetic-rubber industry is here, and it is here to stay.



DEATH CAR...

ONLY A CHILD'S TOY on an unlighted stairway. Yet as lethal as a speeding truck for killing or crippling. For causing heartbreak and tragedy in someone's home.

Accidents . . . in the home . . . on the highways . . . in factories and offices . . . cost this nation 102,500 lives last year. This tragic toll, preventable to a great extent, was augmented by the permanent disabling of 350,000 other people . . . by 9,000,000 lesser casualties.

Production-wise, America's war effort lost heavily. In all, 480 *million* man days were lost forever. Enough to have built a total of 20 battleships, 100 destroyers, 9,000 bombers, and 40,000 tanks! Money-wise, the loss was almost 4 *billion* dollars!

Where did these accidents happen? Two-thirds of them happened outside of industry. In the home, where workers take chances they would not dream of taking on the job. They happened in darkened hallways . . . in bath tubs . . . in garages and basements. They happened in industry where someone gambled with safety.

No matter what you do, your life is precious to this nation. Don't take chances with it. Guard it for America . . . at day . . . and at night. Fight carelessness, the Master Saboteur! Join the anti-accident crusade! Help save a life!

The perfection of the famous "Eveready" fresh DATED flashlight battery called for coordination between various Units of Union Carbide and Carbon Corporation. The exact grade of graphite necessary for the "mix" was developed by the Acheson Graphite Corporation. Special alloy for protecting molds and machinery was produced by the Haynes Stellite Company, and Carbide and Carbon Chemicals Corporation provided a specially prepared paint made of "Vinylite" resins for the spun metal cap.

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Plastics Vital to War and Industry

Not only are plastic parts used in the manufacture of vital war products but they are also better than metal for some heavy-duty applications in steel mills, Dr. G. Frank D'Alelio, head of the General Electric plastics laboratory at Pittsfield, Massachusetts, declared in a General Electric Science Forum address here.

For military use there are plastic helmet liners, plastic parts in every gas mask, and plastic bayonet handles, according to Dr. D'Alelio, whose company is the largest molder of plastics in the industry. He said that the average battleship has more than a thousand different plastic parts on it, and each tank and each airplane contains hundreds of plastic parts. Mortar shells have plastic fuse caps, and bombers have plastic noses. Training planes, landing barges, torpedo boats and invasion gliders are made of plastic-bonded plywood.

Plastics are found in supercharger manufacture, in gun control mechanisms, in radio antenna housings. Firing pins of anti-aircraft shells are made of plastics. There are plastic detonators on torpedoes.

Dr. D'Alelio also mentioned that many of our new vessels will have plastic bearings on their drive shafts, because plastic bearings wear longer and can take tougher punishment than can any other bearing.

"The development of the plastics industry in the last few years, frankly, has been astonishing," Dr. D'Alelio pointed out. "Plastics had long been considered a 'future' even by those most intimately associated with it. Yet, before our very eyes, and under the dynamic compulsion of war, plastics suddenly walked the stage of the present in a major role.

"The military applications of plastics merely prove that plastics can no longer be thought of as an industry devoted merely to making gadgets," the plastics chemist continued. "Our chemists have produced plastics that are crackproof and shatterproof, that are strong and tough; that can do jobs other materials cannot do as well. In a word, plastics are no longer substitutes for metal.

"Plastics today can stand on their own feet, because they can do certain tasks better than any other material.

"For instance, there are heavy-duty bearing applications in iron and steel mills where plastics outlast and outperform metal.

"Rayon manufacturers use plastic rayon-spinning buckets. Why? Because these buckets spin at 10,000 revolutions per minute, are in constant contact with acid and salt solutions, and must operate every hour of the year. No other material can equal the performance of plastics for these spinning buckets, which have an average life of 4½ years.

"For high-frequency radio devices, certain parts must be made of plastics—no other material can give the required performance," Dr. D'Alelio added. "The same is true of hundreds of electrical applications."

Plastics are not one material, according to Dr. D'Alelio.

"Many persons believe that cosmetics cases, bomber noses, and bearings for warships are all made of one and the same plastic," he asserted. "To appreciate fully the importance of plastics and the significance they have in the war of today, we must firmly grasp that the term 'plastics' refers to a whole family of materials. There are actually thousands of them known. Probably a little more than a tenth of this number have wide industrial use.

"Some of these plastics are opaque, others are transparent, some are suitable for use in the freezing temperatures of the Arctic. One type will resist acids, another will stand the abuse that strong alkalies, like postash, can give it. Certain classes will not burn; others will withstand the deteriorating effects of high octane aviation gasoline. Some can be spun into fibers, and others drawn into either flexible or rigid tubing to replace copper and other valuable metals.

"The new synthetic rubbers we hear so much about belong to the family of plastics. Besides the many plastic materials we have today, we are constantly discovering new ones in the laboratory."

The wonderful wartime developments in the plastics industry indicate that after the war we will find plastics of much greater importance in our everyday life, said Dr. D'Alelio. He predicts that houses will have a great deal of construction embodying plastics, and that our very clothing will be made of plastic materials.

NAMES IN THE NEWS

(Continued from Page 15)

Council and is a mechanical engineer with a respectable 3.84 scholastic average.

Tom is quite interested in aeronautical engineering. He thinks the one thing lacking at this University is a good course in aerodynamics and aeronautical engineering. His ambition is to be an aircraft designer. He has a couple of new ideas that he would like to try, one of them being an inline air-cooled airplane engine.

Naturally, Tom has enjoyed his military work the most during his four years at Illinois. At the present, he is busy trying to get the new Honor System installed for members of the advanced ROTC. It will be a system similar to the one at West Point, and Tom thinks the cadets will like it very much. It will make the cadets more conscious of the trust and authority that they carry.

Hailing from Park Ridge, Illinois, Tom is engaged to a certain little co-ed on campus. He thinks his four years at Illinois have been a grand experience. He says, "If you don't think before you get here, you will afterwards."

TRIM TAB FOR AIRPLANES WINS

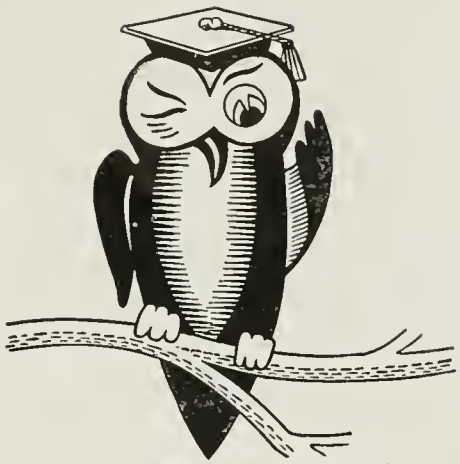
(Continued from Page 27)

The use of plastics eliminates many operations formerly necessary when metal was employed. For instance, the outer skin and longitudinal interior support are fabricated in one piece by a single application of heat and externally applied pressure. Formerly, it was necessary to cut the metal, bend it to form and hold it together by rivets.

Tests prove that the laminated tab possesses a greater resistance to buckling than metal and 25 per cent to 35 per cent more resistance to bending. These tabs have withstood twice the required hours on the vibration tests as compared to a metal piece of similar outside dimensions.

Laminated plastic tabs are valuable in time of war, not only for their lightness and strength, but also for the fact that they may be readily manufactured in mass production by concerns who are not normally burdened with war orders.

Formal announcement of all awards for entries in the Competition was made in the October issue of Modern Plastics magazine, followed by a Presentation Dinner at the Waldorf-Astoria Hotel, New York City, on October 15th.



Get Ready Today

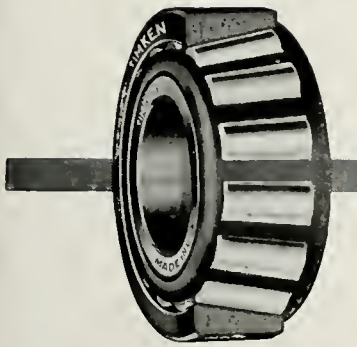
FOR THE ENGINEERING TASKS OF TOMORROW . . . LEARN TO KNOW YOUR BEARINGS . . .

The thousands of experienced engineers who are doing so much to help win victory were students once, and no doubt often wondered what they would do after graduation—just as you probably do now.

But they didn't permit thoughts of the future to interfere with the present. They prepared for whatever might be ahead. Among other things *they learned to know their bearings*—knowledge that has proved to be one of their most useful engineering assets. You'll find it one of yours, too.

After world-wide destruction must come world-wide reconstruction; Timken Tapered Roller Bearings will play as important a part in the new machines of peace as they are doing in the machines of war.

If you have not done so already, begin now to acquire a thorough understanding of the design and application of the Timken Bearing. Our engineers—bearing specialists of many years' standing—will be glad to help you.



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G-E Campus News

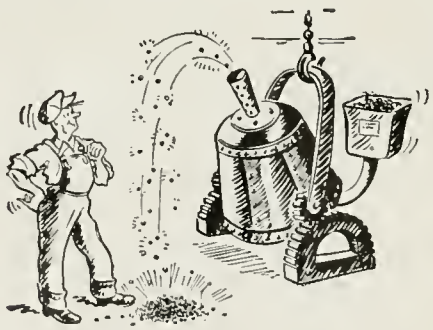
THE HOME GUARD

A DEVICE which can be installed in the home to give both audible and visible warning of air raids has been developed by J. L. Woodworth (U. of Idaho, '24) in the G-E Carrier Current Laboratory.

Designed to operate on carrier current systems, the new gadget makes it possible to contact air raid wardens and civilian defense workers without increasing the load on telephone lines.

When the air raid signal is sent from the transmitter at the power station, the home warning device (which resembles an ordinary house meter) begins to buzz.

After it has thus called attention to itself, the device lights up, and on its dial will appear a colored signal—yellow for preliminary caution, blue for advance caution, red for air raid, or white for all clear—that corresponds to the signal sent from headquarters.



"VEE" JEWELS

THE General Electric Company has developed a method of fusing a special type of glass and forming a miniature jewel. How it's done is a military secret, but the jewels are made on a mass-production basis.

The jewels, called "Vee" jewels (not V for Victory, but "Vee" for the V-shaped depression in which a cone-shaped steel pivot rotates), are in great demand for use in the indicating instruments that measure the flow of electricity in wartime fighting and industrial control equipment. The moving parts of these instruments are of watch size and delicacy, each requiring two Vee-shaped jewels about the size of the head of a pin.

The G-E "gem" has been developed as a substitute for the "Vee" jewels made from sapphires formerly supplied by Swiss craftsmen.

YOUR SMOKE IS SHOWING

A TRAIL of smoke often leads enemy submarines to their intended victims, but an electronic tube might help to give the subs the slip by instantly warning the ship's fireman when smoke is coming from the vessel's stack.

General Electric has already put the phototube, most versatile of the electronic tubes, to work in industrial plants to warn of smoking stacks and to save fuel. W. C. White (Columbia, '12), director of the G-E electronics laboratory, thinks a similar arrangement might be used in ship stacks.

A beam of light, thrown across the smoke column in the chimney, shines on the tube. When the smoke gets too thick, the light is blocked and the phototube works a relay which sounds a warning for the fireman.

GENERAL ELECTRIC

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APPROXIMATELY 30 billion kilowatt-hours of electricity will be consumed to produce all of the aluminum and magnesium we shall need for warplanes and other uses during 1943.

And every kilowatt of this vast amount of power must be *converted from A.C. to D.C.* before it can be used in the production of these metals.

Most of this conversion will be done by the Ignitron . . . *a new and more efficient mercury rectifier* that is a direct result of Westinghouse "know how" in electronics research.

The vital factor in the efficiency of the Westinghouse Ignitron is the *extreme purity* of its electrodes. The graphite anode must be 99.99% free of certain impurities . . . the mercury cathode, 99.999% free of other impurities!

If certain impurities in the mercury increase 1/1000th of one per cent . . . or in the graphite, 1/100th of one per cent . . . the proper operation of Ignitron will be affected.

Few chemists have the skill, knowledge, and special equipment to solve such a problem of almost absolute chemical purity. For this reason, Dr. E. Bruce Ashcraft . . . micro-chemistry expert of the Westinghouse Research Laboratories . . . was assigned to the job.

Dr. Ashcraft lives in a Lilliputian world of chemical analysis. Tiny test tubes, doll's-size beakers and retorts, polarizing microscopes, spectrographs, a balance that measures the weight of a *millionth of a gram* . . . these are the keys he employs to unlock the invisible world of matter.

With the help of micro-chemistry, Dr. Ashcraft has made possible the control of the extraordinary purity of all graphite and mercury used as electrodes in Ignitrons.

And now, *electronics at work* are bringing victory closer every day . . . for Ignitrons with a rated capacity of more than 3,000,000 kw are turning out the thousands of tons of aluminum and magnesium upon which our Arsenal of Democracy depends!

* * *

WE SALUTE DR. ASHCRAFT and the other thousands of scientists who are working for victory in research laboratories all over America.

We also salute the scientists of tomorrow . . . the engineering students now in college who will be called upon to rebuild a war-torn world.

Westinghouse Electric & Manufacturing Company, Pittsburgh, Pennsylvania.

TOM THUMB CHEMISTRY . . . Dr. E. Bruce Ashcraft examines a specimen weighing less than a microgram . . . approximately 1/50th the size of a grain of ordinary table salt. Dr. Ashcraft received his B.S. at Texas A&M, and his Ph.D. at Cornell University in 1937.

Westinghouse

PLANTS IN 25 CITIES—OFFICES EVERYWHERE

JANUARY ★ 1943

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Published Eight Times Yearly by the Students of the College of Engineering, University of Illinois

Published eight times during the year (October, November, December, January, February, March, April, and May) by The Illini Publishing Company. Entered as second class matter, October 30, 1921, at the post office of Urbana, Illinois. Office 213 Engineering Hall, Urbana, Illinois. Subscriptions, $1.00 per year. Single copy 20 cents.

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Frontispiece . . .

The spinning of this 30-ton wheel soon will rotate the propellor and drive one of the United States Maritime Commission's new 21,000-ton oil tankers. Standing 13 feet high, the wheel is the rotor or rotating part of a 6,600-horsepower motor being built by the Westinghouse Electric and Manufacturing Company. The workman in the foreground is polishing the journal of the rotor's shaft, while the other man inspects the insulation of the stationary part of the motor. Westinghouse already has built 12 of these motors for the Sun Shipbuilding and Dry Dock Company and is now constructing 28 more. *(Cut Courtesy Westinghouse).*

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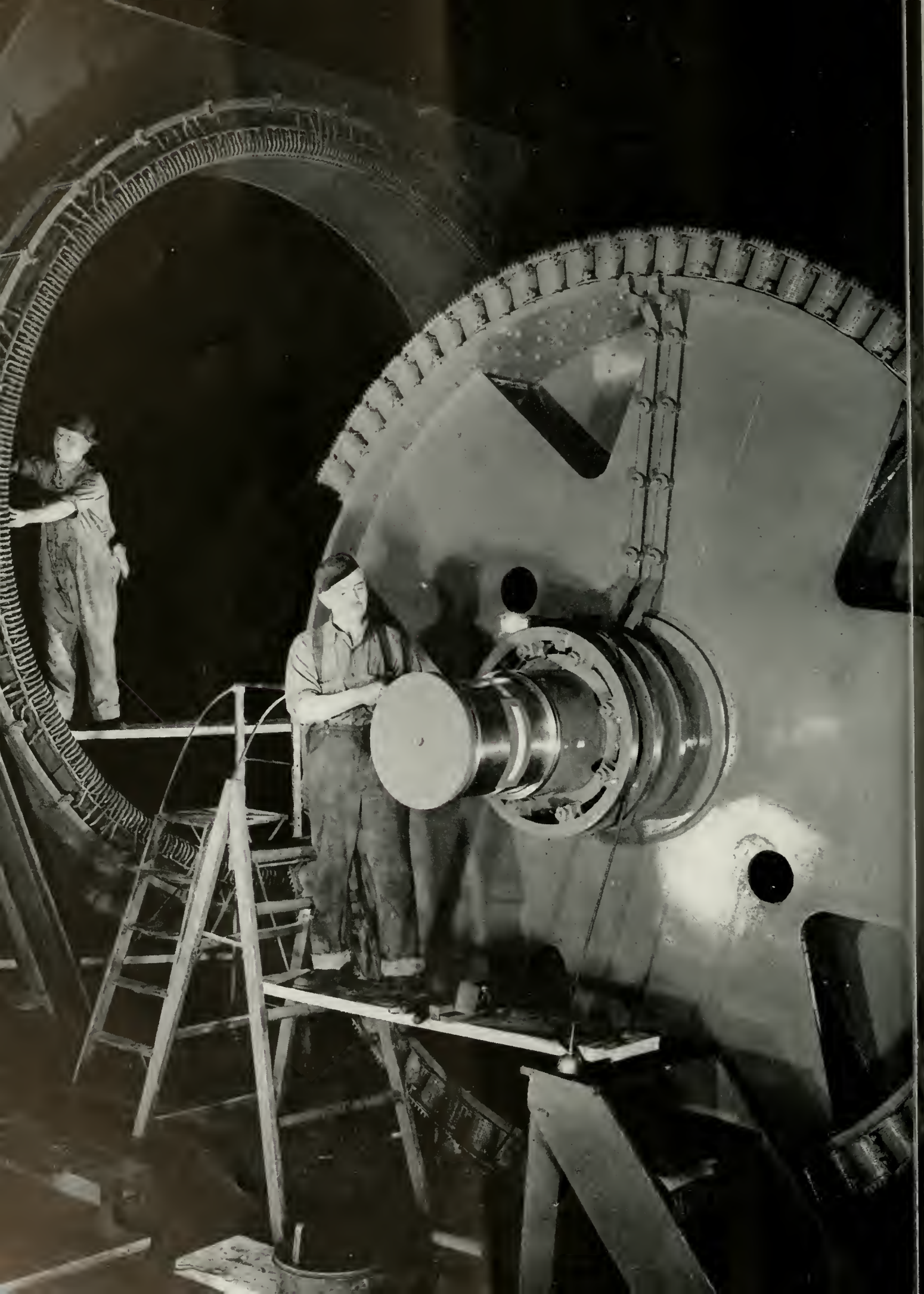
Cover . . .

Men getting instructions on halyard flags at the U. S. Navy Signal School here at the university. The man in the left foreground is sending blinker. *(Official U.S. Navy Photo).*



SHOULD ALL ENGINEERS BE IN UNIFORM?

By SOL DAVID LARKS '43

This theme was chosen as the best written by the pledges of Tau Beta Pi, Alpha of Illinois, as part of their fall initiation. This theme will compete with others from all over the country for national honors.

With the shortage of technically trained manpower already acute, a contribution toward more effective use of the existing engineering cadre can be made by putting every engineer in uniform. At the present moment, the most efficient use of the nation's engineering manpower is not being made. There do not exist, as yet, the organizational guarantees that the right man will be in the right place, in spite of the demands of present-day war.

Under the conditions of modern warfare, there is very little demarcation between the home front of production and the war front. A few hundred years ago, it was perhaps possible for the small mercenary army of those days to go off to war with relatively little effect on or relation with the economy of the home population. By contrast, the mechanized army of today demands the closest integration with industrial production. A breakdown of industrial production would mean catastrophe just as surely as would a break-through at the front. Appraising the needs of both battle and home fronts, it is clear that both need trained manpower—both need engineers.

Now let the question be put in this way: from the point of view of contribution to the war effort, how much difference is there between the engineer in a factory who helps to increase the production of machine guns and the engineer in uniform who aids in rapidly transporting these machine guns at the front? Clearly there is very little difference, if any. Then there should be no difference between them in the eyes of a nation mobilized for war. Further, it should be equally clear that, for maximum effectiveness, every engineer should be at the post where he can contribute the most. If the best communication engineers are needed at the front, that is where they should be assigned. If the best mechanical engineers are needed in the factories, then that is where they should be assigned. But is this the way this problem is being solved? Let us look into it a bit.

How is the problem being solved now? The answer is complex. Some engineers, noting the appeal of the armed forces for technicians with their specific training, have voluntarily entered, by commission or enlistment. Others, even with the knowledge that they would not work in the field for which they had been trained, have nevertheless, from high patriotic motives, joined the Army. On the other hand, thousands of young engineers of unquestioned patriotism, are entering industry because of a strong and understandable desire to acquire industrial experience at once. Yet, going into factories at this time, as young men of military age, they necessarily must request draft deferment. They know that they must face growing questioning looks and glances as the war proceeds, and growing social criticism, both during and after the war.

Older engineers, in the majority, being already rooted in industry for years, feel for the most part that they are making their maximum contribution right where they are. Some engineers have been drafted, and are now doing work which less trained people could do. Again, some engineers are teaching, on a level such that many people with much less technical training, including women, could easily replace them. Thus far, not enough has been done to examine this problem, to determine definitely whether each engineer is now serving at the post where he is most needed. In passing, it might also be noted that the competition which has existed between sections of the armed forces for engineers, as well as the competition between the armed services and industry, is inefficient.

How should the problem be solved? In order to strengthen the nation's war effort, it is proposed here that every graduate engineer be commissioned in the Armed Forces. Steps in this direction should be initiated for student engineers in their senior year. Allocation of engineers between the various subdivisions of the Armed Forces, and between the Armed Forces and industry, should be made by a joint board which should include representatives of the armed services, the War Manpower Commission, and the professional engineering societies.

Since every engineer, under such a program, will be in uniform and under assignment, there should exist a greater tendency and possibility to put the right men in the right place. Because it will be immediately clear to all that every engineer will be assigned to the place where he is most needed, there will be no criticism of the engineer in industry. In addition, the inefficient competition which exists between the armed services themselves for engineers, as well as between the armed services and industry, will be greatly reduced. Flaws there will be, undoubtedly, but such a broad decision will be a step in the right direction—a step which will mean more efficient use of that critical commodity, the technically trained manpower of the nation.

GREATER COMFORT FOR THE FORGOTTEN MAN

By J. R. FELLOWS

Assistant Professor in Mechanical Engineering

Modern, thermostatically-controlled heating systems in which fuels of different types are fired by intricate mechanical devices, when properly designed, are capable of maintaining the temperature in all parts of the rooms they heat within one degree of the desired temperature. Until the production of all non-essential equipment was stopped by our country's entry into the present world conflict, these miraculous products of engineering skill and ingenuity were available in a number of competing types to any one who could spare the cash to cover the cost of an installation which graded upward from around $500.

Unfortunately the great majority of our citizens are caught in the lower and middle income brackets and cannot afford the luxury of automatic heat. This large group which has been referred to as the "forgotten man" has indeed been forgotten by the heating engineer. With few exceptions, the hand fired stoves of today are fundamentally identical with the stoves used during the childhood of those of us who were born "thirty years too soon."

Most householders who use hand fired furnaces of one type or another, use them instead of automatic heating systems because their income will not cover all the things desired by themselves and their families. They prefer to hold the cost of heating to a minimum so that they will have more to spend on food, clothing and entertainment. Since bituminous coal is the lowest priced fuel throughout the greater part of the country, it is the logical choice for the majority of householders who heat their homes with hand fired furnaces.

Though many of the younger generation have been privileged to live in comfortably heated homes since birth, there are few of mature age who have not at some time experienced the alternate "searing overheat" and the "uncomfortable chill" of the average home that is heated by a hand fired furnace burning "soft" coal. The above mentioned performance characteristics of the hand fired coal furnace, together with the frequent necessity for rekindling the fire and occasional explosions makes winter the dreaded season in the average home of the worker whose income is in one of the lower brackets.

A technical analysis of the process of burning bituminous coal in the conventional hand fired furnace soon discloses that furnaces of this type are not properly designed for this fuel. When a charge of coal is placed in a conventional furnace in the conventional manner as shown in Figure 1, either overheating or wasteful operation is inevitable. The coals from the previous charge soon heat the fresh coal, and the volatile matter which may contain nearly one-half of the entire heating value of the charge is converted to a gaseous state. If the overfire air ports in the firing door are adjusted to supply sufficient air for the combustion of the gases as they are released and the bed of coals is hot enough to produce flames, the greater part of the volatile matter is burned within thirty minutes after firing and the house becomes badly overheated. If the overfire air ports do not supply enough secondary air to burn the gases completely, the hydrocarbon molecules break up into hydrogen and carbon and the carbon issues from the chimney as a black smoke and settles as a mantle over roofs, walls, walks and porches. It is impractical to provide sufficient secondary air to completely burn all the gases liberated during the first half hour after firing because the damper adjustment required for this period would provide far too much air throughout the remainder of the cycle and this excess air would carry more heat out of the chimney than would be saved by burning the gases completely. If the coals on which the fresh fuel is placed are not hot enough to ignite some of the gases and cause a flame, the heat that would be liberated by the combustion of the gases is not released and the gases pass out of the chimney unburned to pollute the atmosphere of the neighborhood.

A study of the hand fired furnace which was made in the Mechanical Engineering Laboratory by Professor A. P. Kratz, Mr. J. C. Miles and the author with some suggestions by Professor P. E. Mohn has evolved a new design adapted to the burning of high volatile bituminous coal. A longitudinal vertical section of the furnace is shown in schematic form in Figure 2. The front portion of the furnace is used for the first stage of the combustion process, namely the coking of the coal in which the volatile

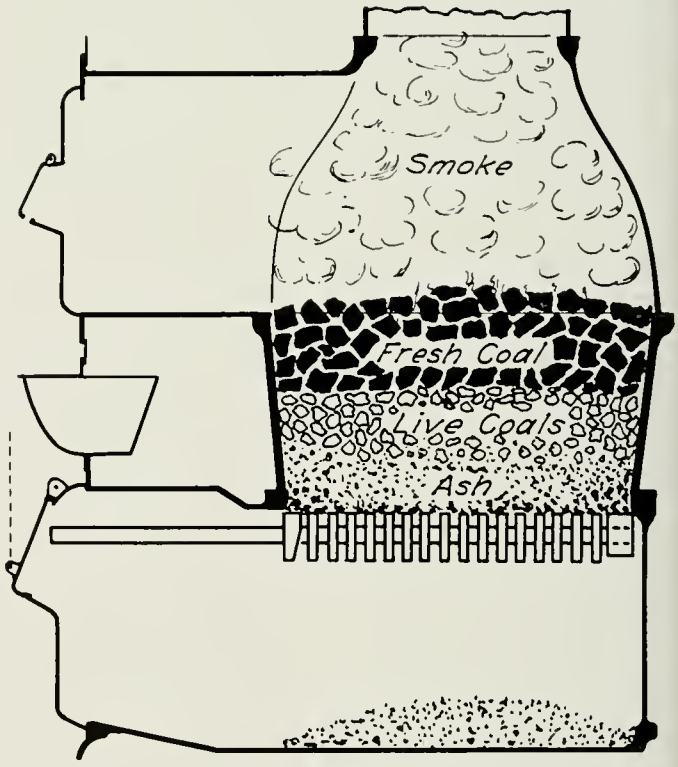


Figure 1. Sectional view showing the fuel bed of a conventional warm air furnace after placing a charge of fresh coal.

matter is gradually converted to the gaseous state by heating the charge from the edge. The rear portion of the furnace is provided with a conventional grate in the conventional position and is used for the second stage of the combustion process, namely the burning of the fixed carbon contained in the coke. The floor of the coking chamber is sloped

at an angle of approximately 45 degrees to make it easy for the householder to push the hot coals or coke from the previous charge into the coke burning chamber at the back of the furnace before placing a charge of fresh coal at the front. The door is also placed at an angle to make it easy to fill the coking chamber from a coal scuttle.

Figure 2 shows the furnace in a freshly charged condition with the coke burning chamber filled with coke and a charge of fresh coal in the coking chamber. Since only the edge of the charge is heated by the hot coals, the

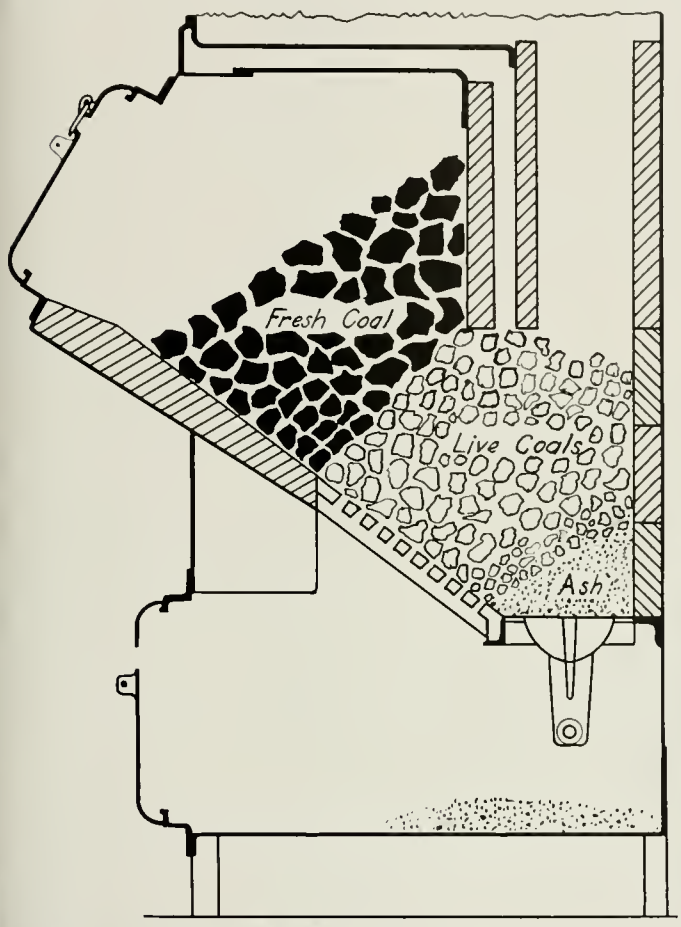


Figure 2. Sectional view showing the fuel bed of the new smokeless furnace after placing a charge of fresh coal.

volatile matter is not converted to the gaseous state as rapidly as in the conventional furnace. It has been found by experience that a period of from three to six hours is required for the complete coking of a charge of fresh coal instead of one-half hour as in the conventional furnace. Because there is no period in the cycle when the volatile matter is converted to gas at an excessive rate, it is possible to adjust the secondary air ports to supply sufficient secondary air for the complete combustion of the gases coming out of the fresh coal during the coking period without supplying an excessive amount during the rest of the cycle. The baffle wall at the rear edge of the coking chamber serves the double purpose of mixing the secondary air with the gases as they come out of the coal, and directing the mixture over the incandescent surface of the burning coke where the ignition of the mixture is accomplished. The hydrocarbon gases from the coal are completely burned to carbon dioxide and water vapor in the small combustion chamber directly above the coke burning chamber and the products of combustion are conducted through a two pass heat exchanger before being released to the chimney.

A crude experimental model was designed and tested with Franklin County, Illinois coal during the summer of 1939. The experimental furnace was later tested with eight different types of high volatile bituminous coal besides anthracite coal, coke, and wood during the winter of 1939 and '40. The tests clearly indicated the superiority of the design over the conventional updraft furnace for the burning of bituminous coal and an application for a patent was made on March 6, 1940. United States Patent Number 2,295,781 was granted to J. R. Fellows and J. C. Miles on September 15, 1942 and immediately assigned to the University of Illinois Foundation. The design principle covered by the Patent is applicable to all types of hand fired coal burning appliances such as stoves, furnaces, boilers and water heaters.

The Majestic Company of Huntington, Indiana, has agreed to pioneer a small furnace embodying the design principle covered by the patent and have been granted sole manufacturing rights for this one application of the principle in the States of Illinois, Indiana, Ohio and Michigan.

The engineers of the Majestic Company have collaborated with the aforementioned members of the University of Illinois Engineering Department in the design of a small unit suitable with slight modification of the casing for use as a forced circulation warm air furnace, a gravity circulated warm air furnace or a circulating heating stove. The University has purchased the first unit manufactured by the Majestic Company and it is now installed in the Mechanical Engineering Laboratory where it will be used for further tests and studies. Figure 3 shows the unit,

(Continued on Page 20)

Figure 3. Photograph of the first commercial unit which is installed in the mechanical engineering laboratory.

The Case for Welding

By WILLIAM G. MURPHY, C. E. '43

The War Production Board has ordered that every possible saving be made in steel construction for the duration. Thinking engineers realize that this saving must not be made at the cost of strength in the structure, nor is it practical to use temporary materials in buildings that are to be used permanently.

Representatives of each type of construction have presented their case to construction engineers. Welded construction gives a saving in steel and doesn't sacrifice any strength since it eliminates the ordinary connection pieces. In a riveted construction it is necessary to use a third member as a connector, while welding permits direct connection of the two members through a weld. In spite of the saving the welding of joints is not a war measure; it was developed to make a saving in fabrication and to overcome both shop and field difficulties of riveting joints.

A conservative designer immediately asks questions about the strength of this type of construction. He wants to know if the method is practical and safe.

Welding is definitely safe since there has been no major failure of this type of construction. It is practical now more than ever in construction work where previously rolled shapes have been discontinued and it is necessary to build the desired structural shape from those available. The various types of welds that can be used to make desired shapes are shown in Fig. 1. They are divided nito two general classifications according to the joint produced: butt welds where two plates are placed edge to edge or fillet welds where the plates overlap.

In order to maintain the safety of the construction skilled welders must be obtained. The ability of a welder can be determined by tests. Require them to weld plates together with a fillet weld and after the metal has cooled, break them apart . . . . "the weld metal should be bright, dense, even-textured, and crystalline or fibrous; and there should be good fusion of the weld and base metals, and good penetration into the right angle corner of the fillet."[1]

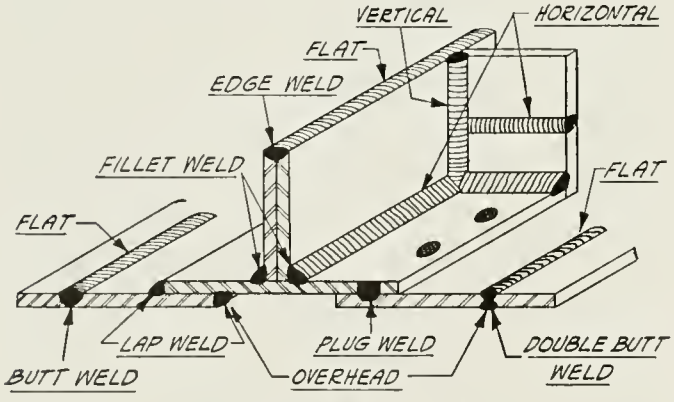


Figure 1. Types of Welds

Cut from *Procedure Handbook of Arc Welding Design and Practice, Courtesy Lincoln Electric Company*

Next require them to make two butt welds as shown in Fig. 2. These plates are cut into five two-inch strips and the reinforcement is ground off. These strips are tested in tension and must average about 45,000 lb. per sq. in. with no strips to test at 40,000 lb. per sq. in.

Finally the welders should be required to weld a specimen as shown in Fig. 2, using fillet welds. These are tested in shear and the average of the specimens tested should be 44,000 lb. per sq. in.

Inspectors on the job should be watchful enough to see that the welders are making good welds and working with the proper speed. Welded construction results in a saving of manpower also since one man can do the work in a moderate size building. "At the Edison 14-story building in Boston, four welders were used to field weld the 1,314 tons of steel in the building, of which 1,050 tons were

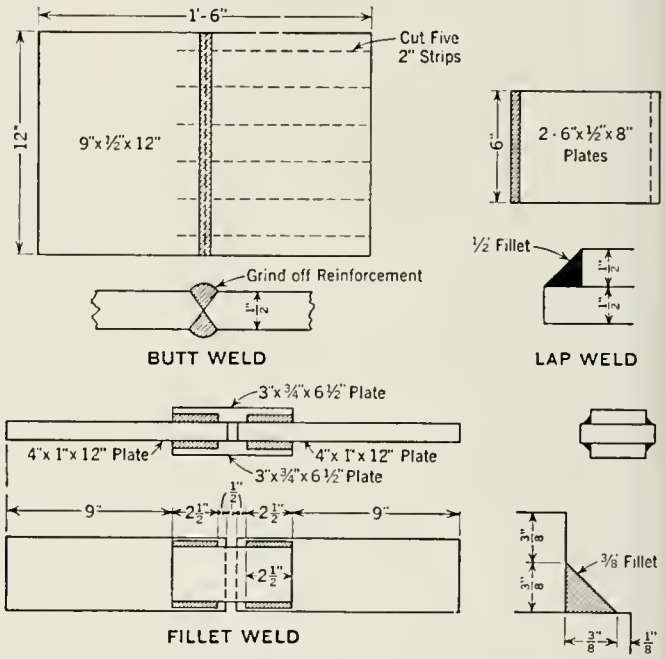


Figure 2. Test welds to qualify welders

Cut from McKibben, Frank P., Arc Welding on Steel Buildings," *Civil Engineering*, Oct., 1930

actually connected by welding, the remainder being largely foundation steel."[2]

Most building codes now have welding clauses or clauses which allow the city officials authority to accept plans for welded construction. Specifications allow a unit shearing strength of 11,300 lb. per sq. in.

Weld calculations use the theoretical throat dimension (see Fig. 3)to obtain the size of the weld. It is obvious that there is a certain margin of safety due to the difference between the theoretical and actual throats. For a 3/8 in. fillet weld the throat distance is 0.266 in. One inch of a 3/8-in. fillet can transmit $11{,}300 \times 0.266 = 3{,}000$ lbs. If the stress to be transmitted is 30,000 lbs., $30{,}000 \div 3{,}000$ is 10 in. If one of the members is an angle, the 10 inches may be divided according to the moments about the opposite fillet.

Using A and B as the lengths at the back and toe respectively, the lengths may be computed by $A = Px_1\ sd$

1. McKibben, Frank P., "Arc Welding on Steel Buildings." *Civil Engineering*, Oct., 1930
2. Ibid.

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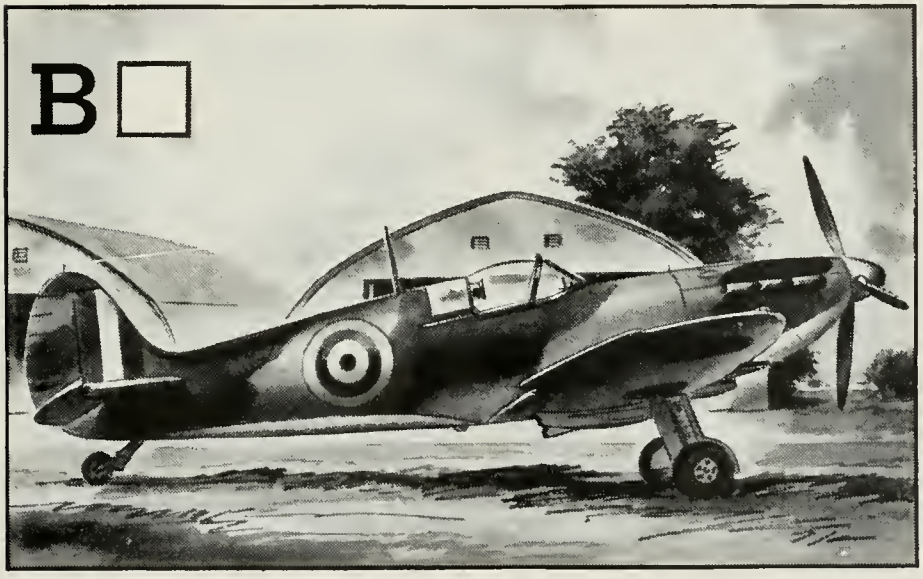

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NAMES *in the* NEWS

By WILLIAM R. SCHMITZ, Ch. E. '45
and
LEE A. SULLIVAN, M. E. '43

GEORGE MAYS

George Mays has accomplished something that few of the engineers here at Illinois ever do. He has already graduated once. He graduated from the University of Tulsa with honors in commerce. He worked for two years with the Carter Oil Company, before deciding that he would like to know something about the engineering side of the oil industry. Since Illinois had a very good name around his home town of Tulsa, Oklahoma, he came to Illinois to get his engineering degree.

A mechanical engineer, taking the petroleum option, George has done okay for himself. He has a neat 4.5 scholastic average. Better known as Elmore to some of his friends, George is a member of Tau Beta Pi, treasurer of A.S.M.E. and is president of Pi Tau Sigma. He is also proctor of his fraternity, Lambda Chi Alpha.

George says that he gets a lot of pleasure out of his work

GEORGE

with fraternities. He really enjoys the contact with the boys. On the sidelines, he likes to play a clarinet and to box. In the summer, he also does quite a bit of saleswork.

According to George, the biggest advantage of Illinois is that it has men of its faculty who have really accomplished something in their respective fields. George says that the chief goal of his life is to be happy, and to be successful in some phase of the oil industry.

HOMER PRATTE

Homer Pratte is one of the best chemical engineers here at Illinois. He is president of A.I.Ch.E., member of Sigma Tau, Coast Artillery Club, and is a 1st Lieutenant in the Coast Artillery of advanced ROTC. Homer has worked a lot with Boy Scouts and enjoys outdoor activities, especially camping.

Here on the campus, Homer hasn't done much dating. He prefers to make up for lost time when he goes home to East St. Louis, Illinois. He says that he had his best time last Homecoming when he had his girl up for the week end.

Homer has had to work quite a bit in order to get through school. At the present time he is working for Prof. Babbitt in the water sanitation department. The subjects

HOMER

that have particularly pleased him are German, organic chemistry, and chemical engineering research. In that, he is working on the evaluation of a laboratory fractionating column. Homer has done very well for himself since coming to Illinois as shown by his good 4.27 scholastic average.

Besides being quite a music enthusiast, Homer has a good tenor voice. He likes to listen to the radio, especially to semi-classical music and to musical operettas. When he graduates, Homer will join the army as a Lieutenant. He says that if he has to remain in the army for several years, he might make the service a career. Otherwise he wants to be a chemical engineer.

PAYSON SHONKWILER

Payson Shonkwiler, better known to all his friends as Shonky, came to Illinois after spending two years at McGill University, which is located in his home town of Montreal, Quebec, Canada. When asked why he happened to come to Illinois, he said, "Well, my dad went to Illinois and I wanted to take ceramic engineering, and since Illinois has

PAYSON

a good ceramic engineering school, I just naturally came to Illinois."

It seems that Payson spends a good portion of his extra time across the street at Presby Hall, where he is quite well acquainted with a certain young lady. He likes dancing and the parties given by the Y.M.C.A. and McKinley Foundation.

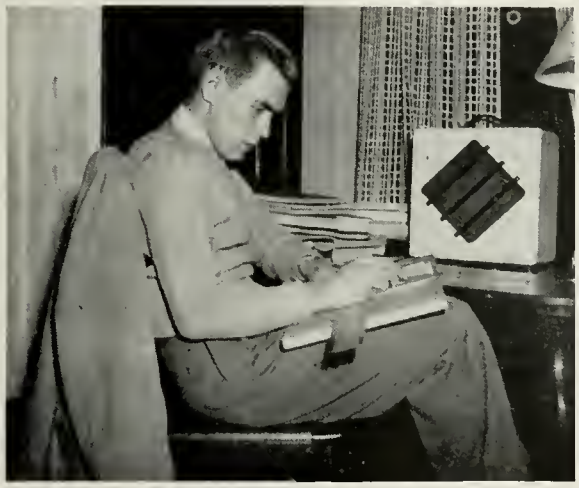
Payson is president of S.B.A.C.S., member of Keramos, Theater Guild, Pierrots, Sigma Chi, and a cabinet member of the Y.M.C.A. He plays the saxaphone and gets a kick out of working with the boys at the Y. Shonky has been making pottery as a hobby. He bas several nice looking lamps, ash trays and other articles in his room.

When he graduates, Payson plans to enter the Harbison Walker Refractory Company and work in the research laboratory. When querried what his life goal was, he replied, "I hope to be a happily married man making a comfortable living."

OTTO JOHNSON

Otto Johnson is an agricultural engineer. He is a member of Tau Beta Pi, Phi Eta Sigma, Agricultural Engineering Club, and is president of Sigma Tau. He is also one of those distinguished students who wears the scholarship key.

Hailing from Seneca, Illinois, Otto came to Illinois because he felt that Illinois had one of the best well-



OTTO

represented schools in the country, and is definitely superior in many engineering fields. Otto has especially liked his T.A.M. subjects, which have helped contribute to his good 4.45 scholastic average.

Otto is one of those lucky fellows who will graduate in February. He is in the Air Corps reserve and expects to be called to duty in March. Otto's favorite sports are bowling and tennis. He also has a coin collection in which he has a gold three cent piece.

According to Otto, the greatest thrill that he has experienced was when he pledged Tau Beta Pi. If there is anything that irks him, it is when some fellow edges in front of him when he is about ready to check his hat and coat and proceeds to check about a half dozen.

GUS SIMPSON

One of the best military men to come along at Illinois in recent years is Gus Simpson. Gus has made military his hobby and business ever since he was fifteen years old. At that time he enlisted in the National Guard in his home town Margate City, New Jersey. He served three years with the Field Artillery of the National Guard before

GUS

coming to Illinois. He says that one of the main reasons for coming to Illinois was because of its fine ROTC unit.

Gus is a Cadet Lieutenant in the Field Artillery and has a neat 5.0 average in military. He has won several medals and cups during his military career. Gus is not just a military man, but is also a metallurgical engineer. He is president of M.I.S., president of the Caisson Club, member of Military Council, and Blue Pencil.

The most important thing that has happened to him so far, Gus says, is the many swell people he has met out here. The people here are a lot nicer than those in the East. Gus also adds that this is the most democratic place he has ever been in.

Like a lot of other engineers, Gus likes to date and to go dancing. Gus believes that he would like to eventually get into some kind of work where he could tie up his metallurgical engineering with the army, probably in some ordnance plant.

VERNON RYDBECK

Vernon Rydbeck is chairman of the A.I.E.E. and recording secretary of Eta Kappa Nu. He is also in charge of the meals at his house, Pi Lambda Phi. Vernon is one of these fellows who have a big smile for whomever they happen to meet.

Among the favorite sports of Vernon are tennis, ping pong, basket-ball, and ice skating. He used to be quite a stamp collector, but has sort of let his collection slip

(Continued on Page 15)

VERNON

Plywood Has Many War Uses

Weight for weight, plywood is stronger than steel and is now used in airplanes, barracks, boats, houses and hangars, Dr. Nelson C. Brown of the New York State College of Forestry, Syracuse, declared in a General Electric Science Forum address.

Today most plywood is made of three or five cross-bands of veneers—thin sheets of wood placed in crosswise directions, layer by layer, Dr. Brown said.

"Plywood is plentifully available," he continued. "Because it has so many uses and lends itself to such a variety of architectural and construction designs, more than a billion feet of plywood are manufactured and used each year.

"The development of water-resistant and heat-resistant glues have revolutionized its use. With the addition of those new glues, plywood can even be immersed for hours in water, or subjected to exceeding high temperatures without changing its size, strength, or shape."

Speaking of its tractability, plywood can be curved, bent, and shaped in many plasticized forms; for instance, in airplanes, according to Dr. Brown.

"It has been widely used in both training and bomber types," he explained. "In fact, one of the most successful British bombers has regularly been made of birch plywood.

"Its lightness in weight and its great strength make plywood ideal for plane construction.

"And many forms of boats are now being made of plywood since the development of those water-resistant glues. It suggests a tremendous utilization, because so many small boats can be quickly assembled from plywood."

Dr. Brown mentioned that the ancient Greeks and Romans used veneer. And until about 1880, veneers were made principally from beautifully grained and handsomely figured woods. They were in great demand for table tops and fine furniture because they added a superior color, grain and beauty to what otherwise would have been rather ordinary-looking furniture.

Today no special kind of wood is necessary for making thin sheets of veneer, the speaker said.

"Almost any kind of wood can be used," he pointed out. "Originally, walnut, mahogany, rosewood, and other cabinet species were very much in demand. Now, because of the large size of logs available and the straightness of the stems, great quantities of Douglas fir are used."

In producing large, unbroken sheets of veneer, the log is placed in a huge lathe and turned against a sharp knife. In this way, continuous sheets of veneers are peeled off the log, until the log, originally from 30 to perhaps 50 inches in diameter, is reduced ultimately to about 8 to 10 inches in diameter.

Among the hardwoods, birch, maple, beech, red gum, walnut, and yellow poplar are used besides Douglas fir to make plywood. And among the softwoods, southern pine, Sitka spruce, ponderosa pine, northern white pine, and western hemlock are commonly used.

Laminated wood should not be confused with plywood, Dr. Brown declared.

"Laminated wood is another form of compressed veneer," he said. "The various piles are laid lengthwise

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NAMES IN THE NEWS

(Continued from Page 13)

since coming to Illinois. His main hobby is sketching and drawing cartoons.

At the present time, Vernon's plans call for him to begin work with General Electric after his graduation in June. He expects to test turbine generators at Schenectady, New York. He eventually hopes to go into sales engineering work.

Vernon lives in Chicago and spent his freshman year at Armour. Then he transferred to Illinois. He said that one of the biggest reasons that he came to Illinois was because of the college atmosphere here. He says that his dating and social life is about par for the engineers, but he doesn't think too much of the average co-ed.

GREATEST BATTLESHIP

Greatest man-of-war ever to be launched is the U.S.S. Iowa, 45,000-ton battleship which went down the ways at one of the Navy yards recently. She will be driven by General Electric geared-turbine propulsion equipment.

This vessel, first of six of the same class, was completed seven months ahead of schedule through the united efforts of thousands of engineers and workmen. Her five sister ships, the New Jersey, Missouri, Wisconsin, Illinois, and Kentucky, are being built at various yards throughout the country.

Some statistics: The plan-design work required 429,000 man-days, and the construction work, 4,100,000 man-days. Blueprint paper used for the issuing of plans totaled 175 tons. Area of all decks and platforms: 418,000 square feet. Some 800 miles of welding was used in construction. The ship has 1,074 feet of shafting to drive her, 80 miles of piping, 16 miles of ventilating ducts, 15 miles of manila and wire rope, 250 miles of electric cable, 900 motors, 5,300 lighting fixtures, 275 service and 816 battle telephones. It took 200 tons of paint to paint her.

instead of crosswise. It is used in the manufacture of gun stocks and airplane propellers.

"Gun stocks look as though they are made from solid wood, and for a long time it was thought that only certain woods could be used for gun stocks. However, several years ago in Europe it was discovered that cheap beech could be used. With the aid of some phenolresin glues, it was found a gun stock of beech could be made that was far superior to one of solid wood.

"In laminated-wood propellers, large-sized laminated forms are made by gluing thin sheets of wood together and then the final product is turned out on a lathe."

The huge consumption of logs for veneers has increased five times in less than 40 years, for in 1905 only 181 million board feet were used annually, according to Dr. Brown.

He said this wood becomes an enormous amount of veneer when you consider that the thickness to which the wood is cut into veneers may vary from as thin as 1-100 up to 1-2 inch. Actually, for commercial purposes, the wood is generally cut between 1-40 up to 5-16 of an inch.

"The stimulus of war has brought about modifications and revolutionary methods of both manufacture and application," Dr. Brown concluded. "Plywood has been caught up and swept along to new and greater usefulness.

"The hand of the forester, the hand of the woodworker, the hand of the scientist—are all apparent in the plywood of today. Its future is too promising to be neglected by the builders of tomorrow."

Scratchboard drawing in Higgins Ink by W. Parke Johnson. Courtesy of American Telephone & Telegraph Co.

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This and other illustrations appear in Higgins new "Techniques." One copy free to art instructors writing on school stationery. All others 50 cents.

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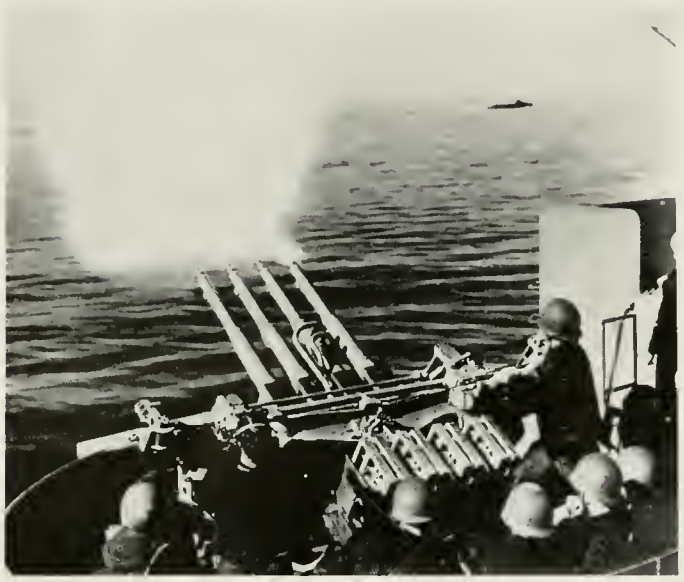
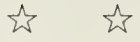
GUN MOUNTS *for* NAVY



—(Official U. S. Navy Photo) (Courtesy Westinghouse)

ACK-ACK IN ACTION—This official U. S. Navy photo shows the 1.1 inch multiple anti-aircraft gun, now in service on every type of American fighting ship in action. This rapid-fire unit, firing hundreds of shells a minute at Japanese planes, played a significant role in the battles of Pearl Harbor, the Coral Sea and the Solomon Islands. The British affectionately call this gun "The Chicago Piano," according to Navy reports.



Record-breaking production of the new American 1.1 multiple gun mounts carrying four rapid-fire anti-aircraft guns—the weapons which hurled hundreds of shells a minute at Japanese planes in the battles of Pearl Harbor, Midway, and the Solomon islands—has been made possibly by large-scale manufacture at the Westinghouse Electric Elevator company, Jersey City, N. J. The new gun units are now on active duty on every type of American warship.

Before Westinghouse tackled the job in the summer of 1940, each gun mount required 8,500 man-hours of labor and cost about $27,000, but assembly-line production methods enabled the company to turn out each unit with about 2,100 man-hours of work at a cost of about $12,000. These 1.1 guns have been produced by Westinghouse at a saving to the Navy of more than 10 million dollars in cost and 4,400,000 man-hours of work. Differences between estimated cost and actual cost were returned to the government. By May, 1942, the company was turning out nearly 40 per cent more mounts each month than its contract called for.

Weighing 14,000 pounds, each mount consists of an adjustable four-foot long horizontal gun support, installed in an H-shaped stand which is moored to a revolving steel base. Each gun support has four large grooves, nine by 13 inches, into which water-cooled gun barrels are inserted. The four guns, although not synchronized, are fired in nearly simultaneous bursts by a single trigger mechanism on the left side of the unit.

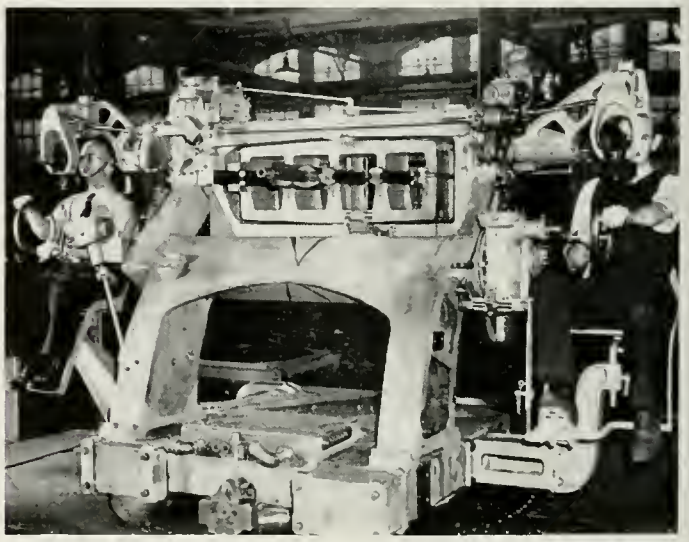
Guided by sights on both sides of the unit, Navy gunners train the guns on flying targets by moving them quickly up or down and left to right. When necessary the entire mount can be swung in a complete circle. The guns are aimed manually by a series of easy-turning cranks near the sights, and also by hydraulic power controls which are installed when the gun units reach a ship. Maneuverability of the mounts depends upon precision manufacturing at extremely close tolerances. This is insured by 4,800 inspections during the manufacturing process, or about six inspections for each of the unit's 800 principal parts.

Principal surfaces must be levelled to a "dead flat" point with an allowable discrepancy of two-tenths of a thousandth of an inch. Other parts must be accurate within four-tenths of a thousandth to a thousandth of an inch. Accuracies required for the units' flat surfaces are too delicate to be achieved by machines, so the required precision is obtained by hand scraping.

Just before the gun mounts are ready for shipment, sights that are used in actual combat are installed temporarily and tested for accurate alignment with gun barrels. Maximum allowable tolerance in this test is one minute, or one sixtieth of one degree—which would result in a deviation by the gun projectiles of not more than ten and one-half inches per thousand yards.

To obtain the necessary manpower to handle this job, men were drilled in fundamentals of machine operation for six to eight weeks. They were taught to operate lathes, screw machines, boring mills, grinding and milling machines, and also received instruction in blueprint reading, measuring instruments, shop mathematics, machine technology, and shop safety. Upon completion of the course, additional instruction was given at night, to supplement work in the factory. Experienced employes were promoted to more difficult jobs and apprentices trained to fill their posts.

Tools for production of the gun units were built by Westinghouse because regular tool manufacturers were overloaded with orders. Some 2,000 special tools, jigs, and fixtures were turned out at a cost of $500,000.



—(Courtesy Westinghouse)

GUN MOUNT TOES MARK—Mount for Navy 1.1 inch anti-aircraft guns is tested for microscopic accuracies. Inspectors are testing gun sights for alignment with grooves where gun barrels will be inserted. Westinghouse cut cost of each unit from $27,000 to $12,000 and work on each from 8500 man hours to 2100.

PLASTIC LICENSE PLATES

Faced with the problem of obtaining a priority for steel for the 1943 motor truck license tabs which must be added to all plates by the first of the year, Wallace G. Kittredge, director of the Commercial Vehicle division of the Commonwealth of Massachusetts, appealed to General Electric for a substitute material with the result that this year's plates will be made of a lightweight laminated plastic. This change not only will save 16,000 pounds of steel, so vital for war production, but will reduce the postage bill three quarters for mailing the tabs.

The tab is manufactured by General Electric of a laminated phenolic compound utilizing the printed and molded process. This consists of placing printed sheets bearing the required design on resin-impregnated sheets of paper, and the whole bonded together under approximately 250 degrees Fahrenheit temperature and 1500 pounds pressure. The pressing operation, which finishes the product in one operation and requires only minutes, converts the resin-impregnated sheets and the printed matter into a homogeneous and strong product having excellent weather resistance. No additional surface treatment is required and after sawing and drilling, the tabs are ready for the fastening to the 1942 plates.

ENGINEERING NEWS BRIEFS

To determine the particle size of pulverized metals, a requisite in the growing field of powder metallurgy, an instrument which shortens from eight hours to fifteen minutes the time consumed in this measurement has been devised by the Westinghouse Research Laboratories.

The former method of using the settling time of the finely-ground metal in a suitable liquid is the basis of the new procedure. Instead of allowing sufficient time for the metal to sink completely, or to a degree affording accurate visual evaluation, the progress of clarification in the supernatant vehicle, usually acetone, is closely recorded at intervals by a photo-electric cell receiving a beam of light being transmitted through the column under investigation. From the rate of change in the degree of capacity is calculated the dispersion of the metal bits.

Not only does this arrangement give a picture of the total effect set up by the interference of the metal to light transmission, but it also gives a selective indication regarding the proportion of different sized particles.

* * * * *

Taming the arc blow that plagues many a neophyte electric welder is now accomplished by use of an oversized version of the familiar horseshoe magnet.

The arc between the electrode and the metal being welded is subject to interference from incidental or stray magnetic forces coming from the current itself that sets up the arc, or from "permanent" magnetism in the metal objects under fabrication. This handicap is demonstrated through wavering or even more lasting deflection of the arc, and sometimes through the arc's being most annoyingly extinguished altogether.

Use of the elongated double bar magnet to straddle the seam smothers or diverts the wandering magnetic forces and promotes faster and smoother fusing. In case of working at or near the end of a section, a single steel bar is quite efficient, say Westinghouse welding authorities.

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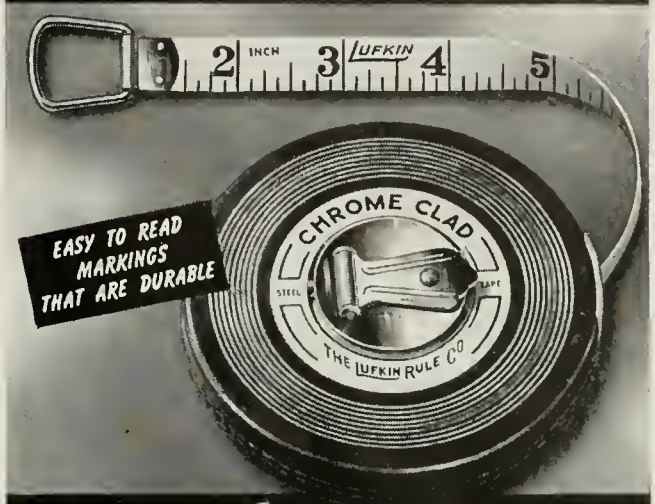

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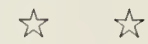
Our Societies . . .

By BYRON M. ROBINSON, M. E. '44



CHI EPSILON

On Dec. 13, 1942, a regular meeting of Chi Epsilon was held at Triangle Fraternity. An interesting discussion, illustrated with slides, was given by Professor Jamison Vawter on "Bombs and Bomb Protection." The meeting was then adjourned for refreshments.

The first business meeting of the year in which the new members were active was held Dec. 18, in the Union Building. At that time, the keys were passed out, and Erasmo Mendez and Carl Mueller were appointed as a committee to arrange for meetings.

Officers of Chi Epsilon for the second semester 1942-43 are as follows:

Ray Ackerman .....*President*
Homer Wong .....*Vice-President*
Carl Mueller .....*Secretary*
Bob Mosher .....*Treasurer*
Harold Schwellensattl .....*Editor of Transit*

A. S. C. E.

The A.S.C.E. held a meeting on December 3, 1942. Professor G. W. Pickels told of the opportunities in the Society, and urged all seniors to join the parent chapter after graduation.

A sound movie entitled "Along the Blue Ridge Parkway" was shown. The picture was in technicolor, and many beautiful views along the scenic highway were shown. They were of particular interest to the engineer as he realized the difficulties which must have been encountered in constructing such a highway "along the skyline."

Mr. W. H. Wisely, superintendent of the Champaign-Urbana Sewerage District, spoke to the C. E.'s on January 7. He told of some of his amusing and educational experiences in his fifteen years as a Sanitary Engineer.

A. S. A. E.

On December 8, 1942, the Ag. Engr's heard Professor G. W. Pickels speak on "Patents and Patent Law." At their last meeting on January 12, two color films on the Furgeson system of farming were shown. The officers for next semester were also elected. The are as follows:

Bob Whitaker .....*President*
Arthur Radke .....*Vice-President*
Gilbert North .....*Secretary-Treasurer*
Donald Hamer .....*Scribe*

A. S. M. E.

The A.S.M.E. held its last meeting of the semester on Wednesday, January 20. The names of the candidates for offices in A.S.M.E. for the next semester were announced. An instructive film on Diesel engines was shown.

TAU NU TAU

At the last meeting of the semester on Friday, January 15, the following T.N.T. officers were elected for the second semester 1942-43:

Dale V. Addis .....President
Ralph L. Lippincott .....*Vice-President*
Jerry S. Dobrovolny .....*Secretary*
Stanley Staniszewski .....*Treasurer*

TAU BETA PI

Tau Beta Pi held its last meeting of the semester Tuesday evening, January 12 in the Illini Union building. The purpose of the meeting was to elect officers for the coming semester. The officers of recording secretary and treasurer hold over from the first semester. The officers for the second semester are:

Byron Welsh .....*President*
Dan Bechly .....*Vice-President*
Homer Wong .....*Corresponding Secretary*
Robert Kallal .....*Recording Secretary*
George Asselin .....*Treasurer*
Leonard Erickson .....*Master of Initiation*

S. B. A. C. S.

The Student Branch is writing a two-page news-letter to the ceramists and ceramic engineers who have graduated within the past three years. Other ceramic graduates will also receive this news-letter if they have maintained even a little contact with the Ceramic Department. This news-letter contains news of the Ceramic Department for the past semester, and should be very interesting to all ceramists from Illinois.

KERAMOS

Keramos held a banquet for its seniors and its new initiates on January 20 in the Colonial Room of the Illini Union. After the banquet, the ceramists moved to the faculty lounge for their meeting. Keramos plaques were presented to the graduating seniors.

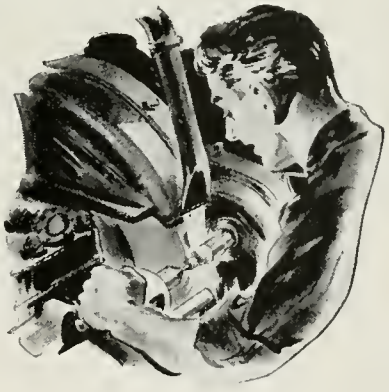
PI TAU SIGMA

Pi Tau Sigma held it's last meeting of the semester in Kamerer's Annex on January 21. The meeting was purely social, with the members furnishing the entertainment. The turnout was very good since it was the last meeting for some of the graduating members. President George Mays predicts next semester to be as full as the last one.

Now they fly ten times as long without overhauling!

The flimsy crates of World War 1 needed overhauling after as little as 24 flying hours. But today's planes fly hundreds of hours at much higher speeds before a major overhaul. The reason? New materials, new designs and new methods of finishing metal surfaces. Finishes so nearly perfect that bearings, cylinders, pistons and cams are made practically wear-proof! It's a process in which Carborundum has played an important part...by supplying the finishing wheels and stones required.

Formerly ultra-finishing was a long tedious task. But thanks to the new process, finishes accurate to a few millionths of an inch can now be produced on ground surfaces on a production basis. Application of these finishes to wartime engine production has improved the fighting efficiency not only of planes, but of tanks and other motorized equipment. Fewer men are needed for maintenance and repair.



Ultra-finishing—is only one of many ways in which Carborundum may be able to help save precious time. When you get out in the field and encounter a production problem that abrasives might solve, write The Carborundum Company, Niagara Falls, New York.

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Greater Comfort for the Forgotten Man

(Continued from Page 9)

set up for test as a circulating heating stove. The duct shown at the right which is connected to a fan not shown, will be used later in testing the unit as a forced circulation warm air furnace.

While hand-fired furnaces, boilers, and stoves embodying the principle of the new furnace will not provide the forgotten man with automatically controlled, constant room temperature, it will enable him to control the fire, avoid overheating and maintain much more uniform house temperatures than is now possible with conventional furnaces. Though he will not be able to forget the heating plant till the "end of the month," it will be possible for him to "get by" with tending the furnace but once a day in spring and fall when the demand for heat is very light. If he buys a furnace, boiler, or stove of the new type that is properly proportioned to the size of his home, it will not be necessary for him to fire it more than two times each day except in extremely cold weather. When he opens the furnace firing door to prepare the fuel bed to receive a charge of fresh coal, the coals from the previous charge will rapidly become hotter instead of rapidly cooling as they do in the conventional furnace. Because the coals become very hot while they are being pushed back into the coke burning chamber, they are in condition to ignite the gases from the fresh coal when it is added. Because the hot coals are not covered with the green coal, the radiant heat from them is not cut off from the heating surface of the furnace and this heat from the coals plus the heat liberated by the combustion of the gases causes the furnace to deliver heat to the house at a very much accelerated rate immediately after the coals are pushed back and fresh fuel is added; whereas the heat output from a conventional furnace decreases when fresh fuel is added until the fresh charge has been heated through by the hot coals buried underneath. The furnace is designed to meet all of the requirements for smokeless combustion of soft coal by supplying sufficient secondary air, mixing the air with the coal gases and passing the mixture over the surface of the incandescent coke bed at the rear. Some smoke is produced if the fire is allowed to burn too low before fresh fuel is added but the inclined grate is arranged ahead of the horizontal shaking grate in such a way that ash may be accumulated at the back of the coke burning chamber in mild weather to reduce the effective grate area and make a possible to maintain the same depth of coke bed and the same rate of burning near the front edge of the baffle wall with a smaller quantity of hot coals. While some smoke will be produced in neighborhoods where most of the heating plants are hand fired with soft coal; even after all of the present equipment has been replaced by improved types; the amount of smoke and soot will be reduced at least 90 per cent and the forgotten man and his family will have cleaner air to breath and his wife will have much less dirt to fight. With less smoke and dirt in the atmosphere the forgotten man will receive more sunlight, and he will be encouraged to take a greater interest in the appearance of his property and a more optimistic view of life in general.

THE CASE FOR WELDING

(Continued from Page 10)

and $B = Px_2/sd$ where P equals 30,000 lbs., s equals 3,000 lbs., d is the depth of the angle or other unsymmetrical section, and x_1 and x_2 are the distances from the back and toe to the neutral axis respectively.

It will be obvious on further study that welding will result in a saving of steel, quieter construction, fewer men to do the work, and the ability to cope with the present problem of unobtainable shapes. Let us hope that as far as the structural engineer is concerned arc welding will win the war.

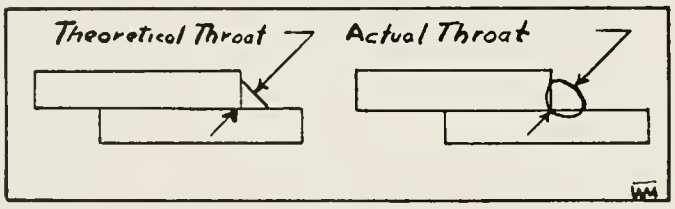


Figure 3. Throat of Fillet Weld

Cut from *Procedure Handbook of Arc Welding Design and Practice*. Courtesy Lincoln Electric Company

BLACKOUT AID

Us of phosphorescent paint as finish for the walls of "blackout" rooms, such as designated shelter sections in plants, gathering places, and especially institutions where movement is necessary during black-out periods, is receiving much attention following research by the Westinghouse Company showing that such finishes, activated by previous exposure to light, sheds sufficient illumination to permit persons of normal vision to move about safely and confidently. As a logical consequence, dyes are now offered which impart the same illuminescence to clothing, extending a pronounced safety factor for air raid wardens and other persons having duties during emergency periods.

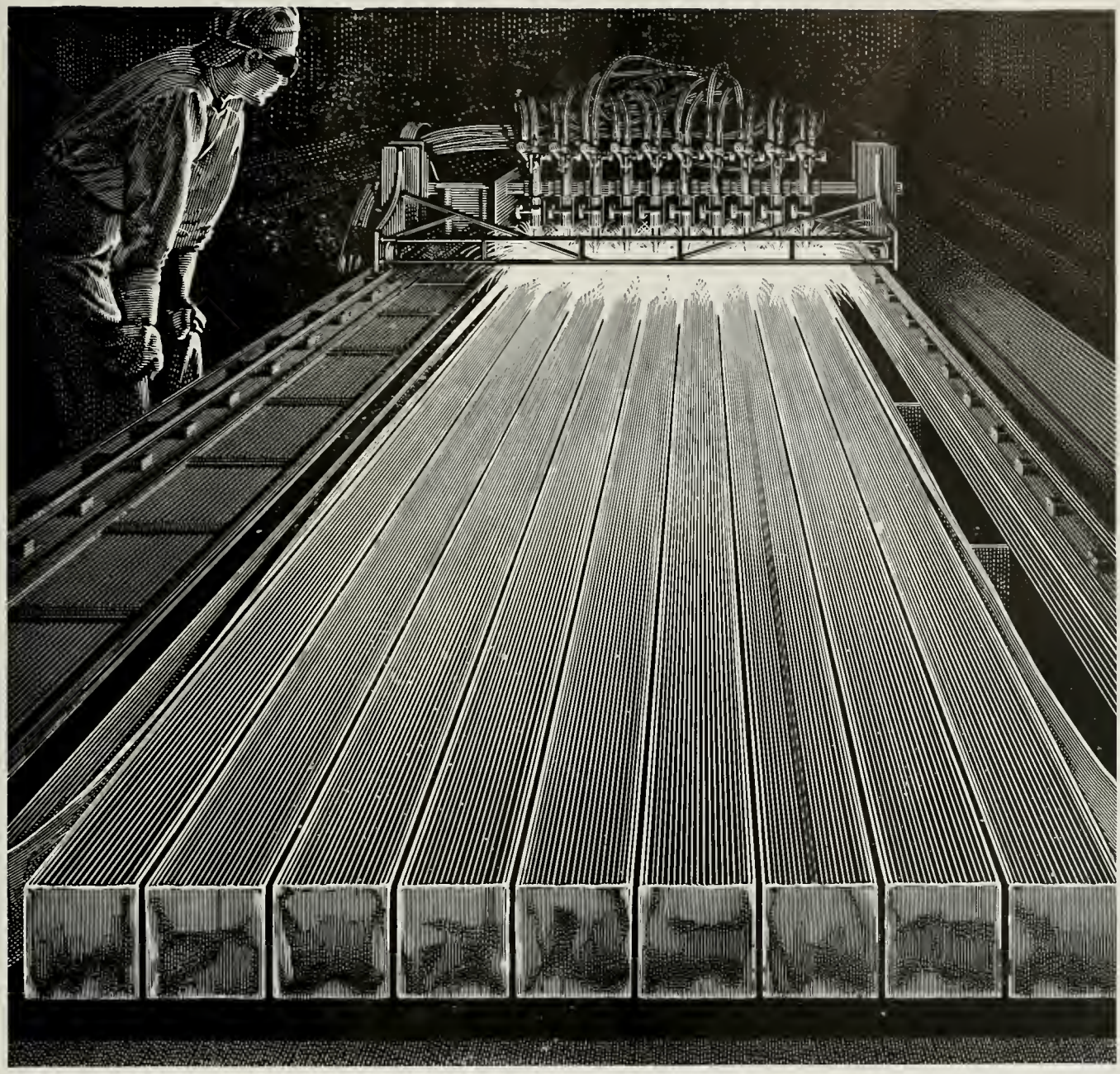
PHOTOTUBE GUARDS AGAINST ACCIDENTS IN COAL PREPARATION PLANT

Loaded coal cars are emptied at the New Piney Fork preparation plant of the Hanna Coal Company, Ohio, by being rolled onto a rotary dump, fastened to the rails by a mechanical device, and then rolled upside down over a chute. After the car has been righted again, it moves off the dump by gravity.

It is essential that the dump does not revolve the next full car until the preceding empty one has moved off. Otherwise, the empty car will be turned over onto the floor.

At intervals, however, the plant experienced difficulty with this arrangement. The dump would revolve before the empty car had cleared. This usually happened because a particular car took too long to move off.

This difficulty was remedied when a General Electric photo-electric relay and light source were installed on opposite sides of the track at the "empty" end of the dump. Now the dump cannot revolve as long as the light beam between the light source and the phototube in the photo-electric relay is blacked out by the body of the empty car.



SLICING STEEL SLABS — and production schedules

STEEL billets were needed. Only slabs were available. That was the problem presented by expanded wartime demands which had to be licked, quickly. It was — by the process illustrated above. Ten oxyacetylene cutting torches, mounted on a frame propelled by two Airco Radiagraph machines, streak down the 140" steel slabs and slice them into billets.

It's one of the many examples of how American resourcefulness, teamed with specialized knowledge, is making minutes more productive. Oxyacetylene cutting and welding and the electric arc are blazing new trails to faster and better production in almost every war industry. The minutes, hours, even days of production being gained by these modern tools are now helping us to overcome our enemies' headstart.

If you work with metals you should know the complete story of the oxyacetylene flame and the electric arc—their speed, efficiency and broad range of usefulness in metal working. This knowledge is vital today—invaluable in the peace to come.

"Airco in the News" shows many interesting uses of the oxyacetylene flame and electric arc. Write for copy.

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TECHNOCRACKED . . .

By PAUL SALERNO, M. E. '43

A recent issue of the Alumni News carried a photograph of the new Abbott Power Plant. The caption said, "The new power plant is as efficient as electrical engineering skill can make it." The editor is lucky that few mechanical engineers read his paper. Or does he think we can't read?

* * * * *

A draftee, commenting upon the speed with which he was inducted into the Army, said, "They take your temperature. If you're warm, you're in. If you're cold, they bury you."

* * * * *

A colored Yankee soldier in England was engaged in a poker game with some British Tommies. He picked up his hand and saw that he held four aces. Anxiously awaiting his turn to bet, he heard someone say, "I'll bet one pound." When the colored boy's turn came, he said, "Ah don't know how yo' all count yo' money, but Ah'll raise one ton."

* * * * *

Prof.: "Name two pronouns."
Stude: "Who, me?"

* * * *

The Ford is my auto, I shall not want (another);
It maketh me to lie down beneath it;
It soreth my soul.
It leadeth me into the paths of ridicule
For its name's sake.
Yea, though I ride through the valleys,
I am towed up the hills.
I fear much evil; my rods and my pistons discomfort me.
I annoint my tires with patches;
My radiator runneth over;
I repair my blowouts in the presence of mine enemies.
Surely, if this thing follows me all the days of my life,
I shall dwell in the bug-house forever.

* * * *

Little Jim: "Are you a *trained* nurse?"
Nurse: "Yes."
L. J.: "Well, let's see some of your tricks."

* * * *

Engineers are often baffled by the fact that some of the girls with streamlined figures offer the most resistance.

PRAISE THE LORD
AND PASS THE AMMUNITION

Enlisted reservist's version:
Praise the Lord and pass me my commission.
Restaurant diner's version:
Praise the Lord and pass the malnutrition.
Senior mechanical engineer's version:
Praise the Lord and pass me my petition.

* * * * *

Officers of the British intelligence conducted a quiz program with some newly arrived American soldiers. "Ask as many questions as you wish about England and we'll try to answer them," they said.

They were stumped on the first question which was, "What is the age of consent here?"

* * * * *

First Little Pig: "My, my, I never sausage heat."
Second Little Pig: "Me neither. I'm nearly bacon."

* * * *

NOMENCLATTER

Silence—The college yell of the school of experience.
Hysteresis—Mental disease suffered by engineers.
Entropy—Side door in a speakeasy.
Stress—Musician who wrote the "Blue Danube."

* * * *

"So I told the freshman to indorse the check his family had sent him."

"Did he do it?"

"Yes, he wrote on the back: 'I heartily indorse this check.'"

"To Love is to Remember"

Sweetheart — Family — Friends

On St. Valentine's Day with

VALENTINES

FROM STRAUCH'S,

The Home of Fine Cards

Humor—Beauty—Originality if you buy them at

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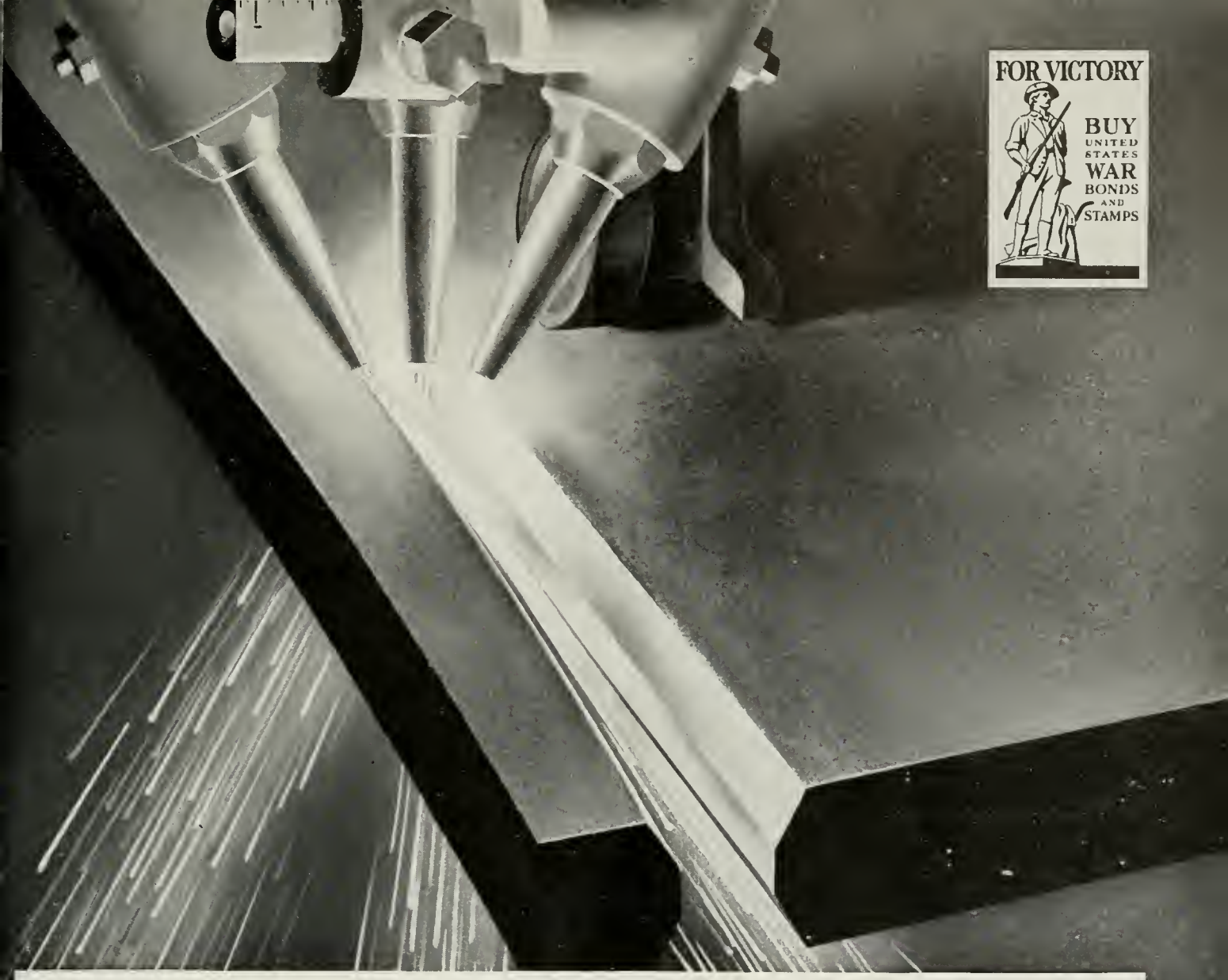
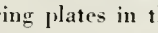


FLAMES THAT CUT TIME!

TODAY, ships are needed as never before. And today, ships are being built as never before . . . and built faster, stronger, and with less steel . . . thanks to welding!

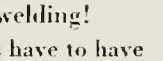
But before welding can take place, steel plates have to have their edges beveled and squared-up so that, when butted together, they look like this: or like this: 

In the past, preparing plates in this manner was done by heavy machine tools. Cutting was slow and costly. Each plate had to be handled many times. Plate cutting on this basis could hardly keep pace with welding today.

Now, oxy-acetylene flames . . . *cutting in different planes simultaneously* . . . prepare the edges of steel plates of any commercial thickness *at one pass* . . . in a fraction of the time required by mechanical methods!

This Linde flame-planing method is as simple as ABC. It is economical . . . and easy to use. It cuts plates so smoothly and accurately that *no machining is necessary!* And it uses materials which can be produced in abundance.

On-the-job power requirements for flame-shaping are negligible . . . for the reaction of the cutting oxygen jet with the hot steel does all the work . . . and only fractional horsepower is required to move the cutting nozzles along the line of cut.

In conjunction with "Unionmelt" Welding . . . an amazing electrical welding process that unites plates of any commercial thickness faster than any similarly applicable method . . . like this  . . . the Linde method of plate-edge preparation is working miracles in speeding up shipbuilding.

These two methods are also helping to break production records in other fields. Great pressure vessels . . . locomotive boilers . . . huge pipes . . . heavy chemical tanks . . . combat tanks . . . artillery mounts . . . and other vital equipment are being turned out faster because of them.

Linde research, intensified today, is constantly solving new problems in flame-cutting, flame-fabricating, and flame-conditioning of metals for war production.

The important developments in flame-cutting—and other processes and methods used in the production, fabrication and treating of metals—which have been made by The Linde Air Products Company were facilitated by collaboration with Union Carbide and Carbon Research Laboratories, Inc., and by the metallurgical experience of Electro Metallurgical Company and Haynes Stellite Company—all Units of Union Carbide and Carbon Corporation.

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

UCC

General Offices: New York, N. Y. Offices in Principal Cities

G-E Campus News

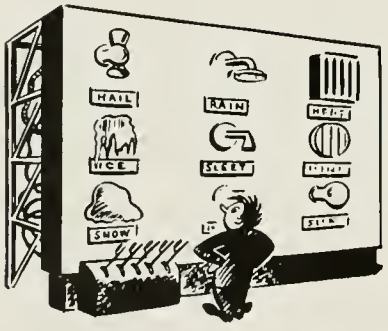
COAST IS CLEAR

FOR three years an automatic traffic control (essentially an electronic device) has been directing motorists through a one-way tunnel that serves as a direct route through a mountain on a Salt Lake County highway in Utah.

The traffic control counts vehicles as they enter and leave the tunnel. If the outgoing count is less than the ingoing, a bell warns a patrolman to go in after the missing car. Thus traffic is kept moving through the tunnel in one direction at a time.

When the carbon-monoxide content of the air in the tunnel reaches a critical point, another electronic watchman stops traffic and turns on a ventilating fan.

Approximately 600 cars go through the tunnel every 24 hours, but the electronic cop isn't tired yet.



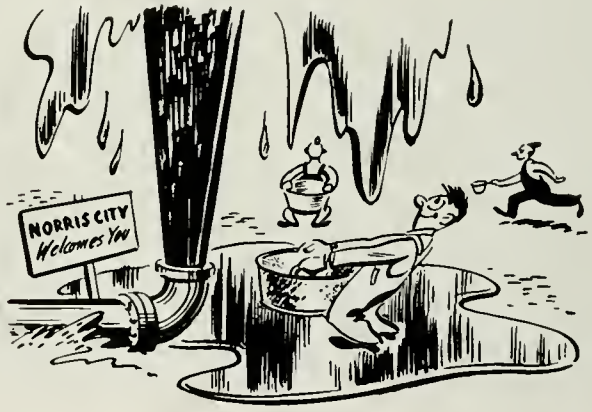
TAKE YOUR CHOICE

THE U.S. Army Air Force can test airplane engines at altitudes of 40,000 feet, where it's 67 below, or at low altitudes over deserts where the temperature soars to 120 F. without taking the ships from the ground.

Testing is done in a laboratory where refrigeration equipment, electric heaters, and air evacuating equipment take over for the elements.

One such lab, for which G.E. is building electrical equipment, will house several test chambers, in each of which engines will be tested under different conditions.

To accomplish this, air will be partly conditioned and then delivered to the various test chambers. At each test chamber the air will be further conditioned to obtain the exact humidity, temperature, and pressure for the particular condition desired. Then the air will be delivered to the engine carburetors.



PIPE DREAM

THE War Emergency Pipeline, largest oil trunk of its kind in the world, will go into operation in January. Extending 531 miles from Longview, Texas to Norris City, Illinois, the "Big-Inch" pipeline (so called because it is 24 inches in diameter) will help alleviate the oil shortage in the East.

G.E. recently shipped, five weeks ahead of schedule, the first two of fifteen 1500-hp motors it is building for the line.

Built of cast iron to conserve steel plate, the motors will be used to drive centrifugal pumps in booster stations along the line. These pumps will keep 1,330,000 barrels of oil flowing at a rate of 4 miles per hour—a delivery rate of 300,000 barrels a day at Norris City.

By June it is expected that the remaining section of the line, 857 miles long, will connect Norris City and the Atlantic seaboard.

GENERAL ELECTRIC

958-52-211

ILLINOIS TECHNOGRAPH

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February
1943

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HEAVY MINERAL SEPARATION

TIMBER CONSTRUCTION

NAMES IN THE NEWS

OUR SOCIETIES

TECHNOCRACKED

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...blished 1885 Member E.C.M.A.

20¢

This is the way to win a battle in the desert

Libya and North Africa made it clearer than ever: THIS IS A WAR OF SUPPLY.

In 1918, an American soldier could be equipped and maintained on 5 tons of supplies each year.

But today, for every soldier sent abroad, *10½ tons* of shipping space must be provided for *equipment alone*. And it takes an additional *18 tons of shipping to supply a single soldier for a year!*

Supply is a matter of *ships*.

And ships need electricity.

Vast quantities of electric power, for a thousand vital tasks that must be done to take a convoy safely across the seas...

Electricity to steer the vessels and operate the radios and signal lights.

Electricity to detect the approach of enemy subs and planes, to sound the alarm, to organize the defense.

Electricity to power great cargo winches, and delicate navigating instruments.

Electricity to make magnetic mines harmless, to provide invisible "black light" for reading charts at night. Electricity to keep food fresh, to cook it, to ventilate the ships, to provide comfort for the crews.

Electricity in every freighter, every tanker, every Navy escort vessel—to help win the war of supply!

We of Westinghouse take tremendous pride in building so much of the electrical equipment, so many of the great turbines and gears and electric drives, for the ships of America's Navy and Merchant Marine.

Into every piece of that equipment go all our "know-how," all our skill, all our determination to *do our share* in this war—and if possible, a little more.

Westinghouse Electric & Manufacturing Company, Pittsburgh, Pennsylvania.

Tune in the Westinghouse Program starring John Charles Thomas — NBC Network, Sunday, 2:30 P. M., Eastern War Time.

Westinghouse

PLANTS IN 25 CITIES — OFFICES EVERYWHERE

FEBRUARY ★ 1943

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Published Eight Times Yearly by the Students of the College of Engineering, University of Illinois

Published eight times during the year (October, November, December, January, February, March, April, and May) by The Illini Publishing Company. Entered as second class matter, October 30, 1921, at the post office of Urbana, Illinois. Office 213 Engineering Hall, Urbana, Illinois. Subscriptions, $1.00 per year. Single copy 20 cents.

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Frontispiece . . .

Marine reduction gears are cut with the greatest precision in an air conditioned room at the Steam Division of the Westinghouse Electric and Manufacturing Company. Once the tooth-cutting operation is started, it must continue without stopping for about seven days at constant temperature to insure the utmost accuracy. The slightest discrepancy would cause a deafening screeching and squealing when these gears turn at high speeds. *(Cut Courtesy Westinghouse).*

★

Cover . . .

The cover this month is a view of the engineering campus with Engineering Hall and the Physics Building in the foreground. The smoke-stacks of the old power plant can be seen in the background.

G.E.C.
G.E.C.

Techniques in . . .

Heavy Mineral Separation

By ROBERT L. MILLER

Heavy mineral studies, although not new, have been used extensively in the work on groundwater at the State Geological Survey Laboratories; and have proved to be of value as a technique to the geologist.

Correlation of the various strata or layers of rock which make up the outer crust of the earth is of great importance to the Geologist. He must be able to accurately determine which strata is which, at any given place. If he has determined the characteristics of, and named a certain strata in one part of an area, he should be able to determine where this strata would be encountered in another part of the area.

If a certain stratum is a good aquifer, that is, if its permeability is such that it is able to transport water, then the Geologist must be able to locate the subsurface position of this strata.

An example is the "St. Peter" sandstone. The source of the water which is pumped out of this formation is in part from Southern Wisconsin and Northern Illinois. Here the St. Peter sandstone is exposed and receives rainfall.

The St. Peter dips to the South until in Will County it is found at a depth of hundreds of feet below the surafce. The Geologist is able to determine this by certain predetermined characteristics of the St. Peter sandstone.

He does this by the following procedure:

A. Five or ten foot samples of the rock encountered in a well from top to bottom, are labelled and sent to the Geological Survey.

B. The positions of the wells are plotted on maps.

C. The samples are studied and the depth of the St. Peter is recorded for each well.

At the State Geological Survey of Illinois, located at the Natural Resources Bldg. on the Illinois Campus, these methods of studying the samples in order to determine the strata have been developed to such a degree that it has approached an exact science in this respect. A group of highly trained Geologists have been employed in correlating the strata in Northern Illinois for the special use of the War and Munition industries located in that area.

Many of the methods used are entirely new and are being introduced by this group. Others have been used for some time and are recognized as accurate. Among these is the method of heavy mineral separations, with which I will now deal.

Figure 1. Separation racks and funnels.

The so-called "Heavy Minerals" are those whose specific gravity is heavier than that of the liquid in which they are placed. Thus a separation is achieved by gravity since the heavy minerals will sink while the light ones will float.

Heavy mineral suites of certain strata may be separated from the rock and determined. The heavy mineral percentage is greater in one strata than in another, and therefore one possible means of correlation is set up.

Some minerals are rare in some strata and common in others. For instance, Kyanite and Staurolite are rare in any strata deposits before the Cretaceous (Geological Period).

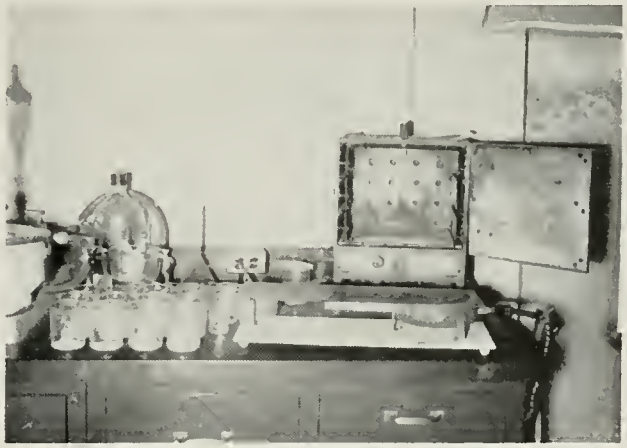


Figure 2. Oven used in drying with hot-plate for making slides in foreground.

Another point to note is that although the heavy minerals Ilminite, Rutile, Magnetite, Zircon, and Tourmaline are found almost universally, their relative proportions, size, and shape, vary in the strata in which they occur, and may be correlated on the basis of this. At this point it must be understood, however, that no one method of correlating rock strata is considered sufficient basis for naming a strata conclusively. The heavy mineral counts are at present a less important means of correlation which is used principally to differentiate lithologically similar sandstones. Thus when other means of correlation fail, a heavy mineral separation will be often of quite great value to the Geologist.

The method employed in separating the Heavy Minrelas from the rest of the rock is as follows:

A sample of sand taken from a well or an outcrop (surface exposure) is run through a set of sieves in order to remove those which are too fine or too coarse for micro-

(Continued on Page 14)

TIMBER CONSTRUCTION

By WILLIAM G. MURPHY, C.E. '43

In the days before the government scrambled the alphabet, engineers could use whatever materials that his judgment and training taught him were proper for the particular structure with which he was concerned. Now he's lucky if he can get anything.

Even before the war, however, many engineers were using wood for more than it had been used in recent structural history. Since the war wood is the watchword of construction and most timber is on a priority basis.

Recently the Illinois specifications for highway bridges went from all steel construction through reinforced concrete to an all wood structure with steel connectors. Now they can't get the wood.

In many ways timber construction is much more suitable for structures than any other material, but since the engineer knew less about the material than steel and concrete, he has avoided its use as much as possible. Due to the efforts of several large concerns design information is available to all for the price of a stamp, and soon there will be no reason at all for ignorance of the possibilities in the field of timber construction.

In considering the advantages of timber construction, the fire resisting quality seems to be the most outstanding of them all. Intense heat will not cause wood to buckle and twist and become almost worthless even for salvage as will steel. The wood will char and burn if exposed to a flame long enough, but there has to be almost complete destruction of the fibers before the structural member will fail.

In one experiment reported by the Timber Engineering Company, several army planes saturated with gasoline and oil were burned in a hangar with timber trusses supporting the roof. After the planes had twisted and bent until useless for further use from the high heat of the fire, the trusses were found to be only slightly charred. Several cases are reported where only minor repairs and surfaces were necessary to put timber structures back into use following fires that would have resulted in the complete failure of steel.

In designing a timber structure it is necessary to consider the strength of the lumber to a much greater extent than when using the other structural materials. Moisture content, amount of summer and spring wood, direction of the grain of the wood to the direction of the load, and the presence of defects in the lumber are the major qualities to be taken into account.

The detailing of a wooden structure requires much more judgment on the part of the detailer than the other types of constructions. In the first few panels of a timber truss, for instance, the number of connectors required to transmit the stress will not fit in the joint using the minimum section to carry the stress. All the requirements for edge, end, and c. to c. spacing must be met in order to prevent the shearing out of a large piece of wood at the joint leaving the connectors partly inactive towards carrying the load.

From an economical standpoint where timber can be used, a large saving will result. The lumber will take up less shipping space and weigh less. Even though the economical span length in trusses is much less for wood, the steel structure would cost the most.

The life of timber is comparable to any steel structure in existence today. Many of the wooden homes and plantation buildings built in the early days of our country are still standing today in good condition. When a steel structure fails there is usually a complete failure of the material necessitating an entirely new replacement. Wood will yield to a great extent before failing and after failure occurs there is still enough life in the fibers to carry a load.

Many of the old bridges in some of the eastern states are made from the old hewn timbers, and they were erected by our forefathers in most cases. With proper upkeep and not much traffic these structures should last for some time. In connection with the yielding of wood, one good trick than can be used in the home is on bookcases with removable wooden shelves. After a number of years the shelves will sag very noticeably. All you have to do is turn them over and let the process repeat itself.

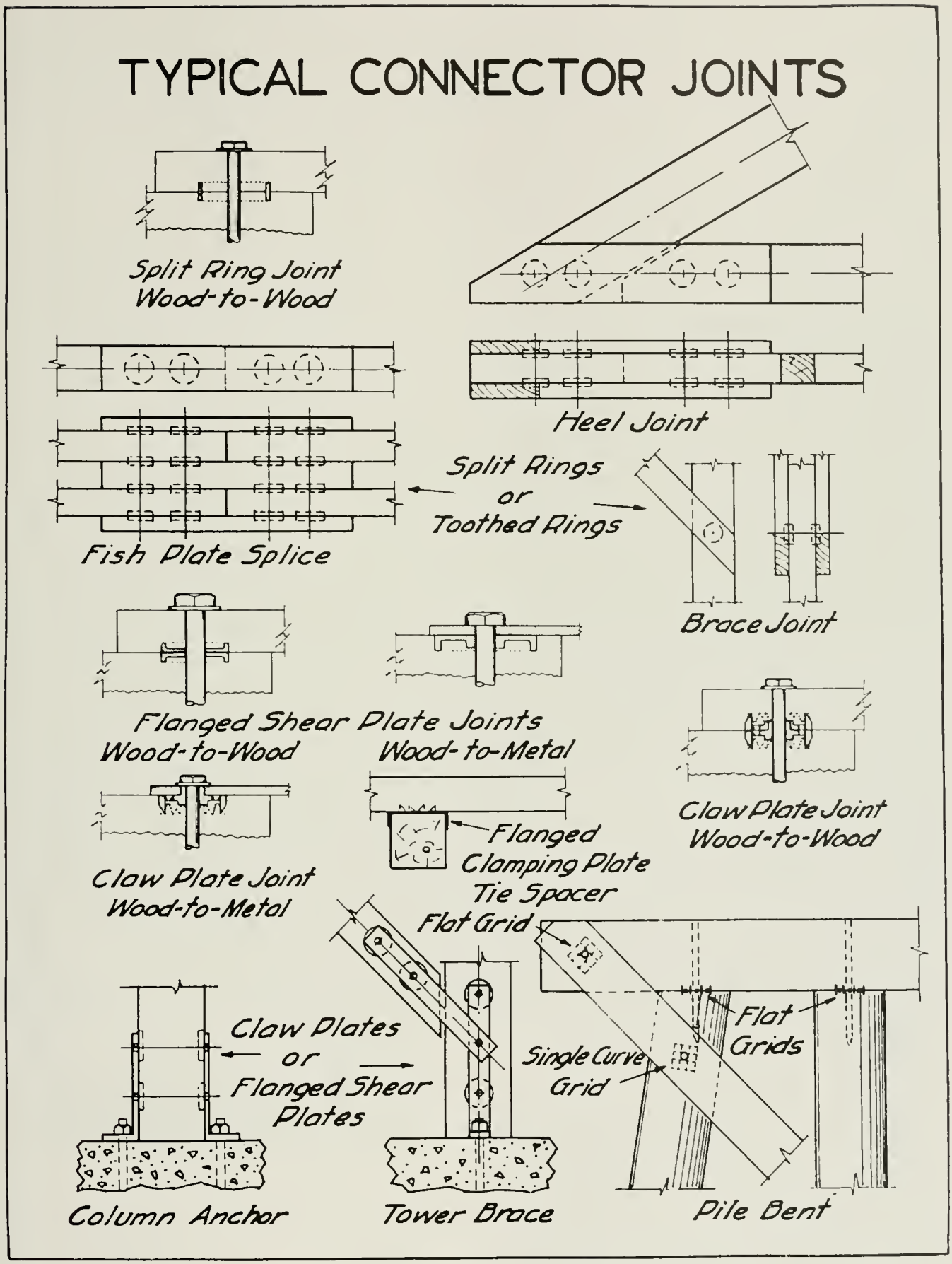
An engineer designing a wooden structure should use the same judgment and professional sense that he would use in any other design. Timber structure utilizes the same principles of mechanics that are the background for all engineering design. Timber engineering companies have developed procedures and have modified the existing column formulas to give the most economical design with timber, but any good engineer with a little thought could apply his mechanics to design and be on the safe side.

The use of timber connectors seems to be the most economical solution to the problem of making joints in a timber structure. The use of bolts and spikes results in a large waste of wood to develop the proper resistance. Timber connectors greatly reduce the size of the joints and allowances can be made for efficiency of the connections by applying the results obtained by research engineers and plotted on charts available from any of the timber concerns. Typical types of joints using these connectors are shown in Plate I.

The development of timber connectors has greatly reduced the amount of calculations necessary for a timber structure. In the past it has been necessary to calculate the various resistances of the drift bolts, screws, or nails. The Timber Engineering Company has published all the research information on the use of these connectors and it has boiled the whole problem down to dividing the stress in the member by an allowable stress.

The use of wood is far-reaching in the field of engineering since it can be used in its various forms from the substructure to the sheathing on the roofs of buildings. Contrary to public opinion the wood does not decay from age. The action of wood attackers, the chief of these being termites, cause most of the trouble. When protected from attack, wood will stand up with any other structural material.

This paper is not intended to advocate the use of wood in every situation. It is the opinion of the writer that it has its place in the structural field and should be kept in its place.



—Cut courtesy of the Timber Engineering Company.

Typical Types of Timber Joints Using the Timber Construction

NAMES *in the* NEWS

By WILLIAM SCHMITZ, Ch.E. '45
and
LEE SULLIVAN, M.E. '46

PAUL SIMMONS

Old Monroe, Missouri claims Paul Simmons, the brilliant engineer with a 4.75 average as one if its future great men. Paul is the member of no lesser organizations than Phi Eta Sigma, Tau Beta Pi, Pi Tau Sigma, ASME, Tau Nu Tau and a cadet Captain in the Engineers as well.

PAUL

Paul is an engineer who believes in rounding out his life. He mixes such sports as basketball, baseball, and football for his athletic life. He confines his attentions to one girl on campus and fills his social life with dances, shows, and informal dates.

Paul chose Illinois because it compared favorably with the other schools which he has visited. He believes that the Engineering school is a good school which keeps up with the times and also has excellent teaching personnel. Paul's favorite subjects are Motors, internal combustion engines, Theoretical and Applied Mechanics, and Mechanical Engineering courses.

Upon graduation Paul expects to be sent to Fort Belvoir which is a replacement center for engineers. Paul leaves the following sound advice for freshmen: "Learn how to study and don't try to get everything, but single out the important things."

HOMER

HOMER WONG

Homer Wong is a scholar and a statesman. He is a member of A.S.C.E., Phi Eta Sigma, Chi Epsilon, Tau Beta Pi, Sigma Tau, and is on the social fraternity committee for the Cosmopolitan Club. He is one of the best civil engineers around the territory north of Green street.

Since coming to Illinois from Galesburg, Ill., Homer has done very well for himself. He has a very excellent scholastic average of 4.7. Structural design seems to interest Homer the most, so he has specialized in that field. Upon graduation, he expects to work in some aircraft factory as a designer.

Homer hasn't done very much dating here at school, not that he wouldn't stand outside Engineering Hall fifteen minutes in order to see a certain little lady pass. Homer also spends a great deal of time reading and listening to the radio. Swimming is his favorite sport.

According to Homer, the thing he has liked best during his four years here at Illinois has been the contacts he has made with the instructors and professors, not to mention the many friends he has made. The school atmosphere and the good times he has had here at Illinois will be one of the most cherished memories of Homer's collegiate career.

DALE ADDIS

From Toulon, Illinois comes this good mechanical engineer. He is a member of Scabbard and Blade, Tau Nu Tau, Pi Tau Sigma, Pershing Rifles, and is a cadet captain in the Corps of Engineers advanced ROTC. He is one of the most likable fellows around the engineering campus.

DALE

Like a lot of the rest of us, much of Dale's attention is now centered around military. He is quite anxious for June to roll around so that he can enter the officer's candidate school and obtain his commission.

Dale is a member of Sigma Pi and likes to do a variety of things. Occasionally he likes to go out on a date, or

(Continued on Page 16)

Every branch of the Armed Services uses the telephone. No. 1 of a series, Anti-Aircraft.

To his mother and dad it seems only yesterday that he was using the family telephone to call his high school sweetheart. But today the orders he sends and receives over his wartime telephone help speed the day when love and laughter, peace and progress shall again rule the world.

Western Electric

IN PEACE...SOURCE OF SUPPLY FOR THE BELL SYSTEM
IN WAR...ARSENAL OF COMMUNICATIONS EQUIPMENT

Fatter Porkers...Faste

A-C Welders now work exclusively on machinery for the war effort.

ALLIS-CHALMERS FARM and milling equipment helps produce corn for U.S. porkers and steers . . . wheat for 8 of every 10 bread loaves produced in the U. S. A.

Allis-Chalmers *industrial* equipment (more than 1,600 different capital goods products) works in every war industry . . . helps produce planes, tanks, ships, guns at a rate which must make Hitler shiver!

And Allis-Chalmers engineers—cooperating with plant engineers in every part of the country—are helping manufacturers *duce more*—not just with new machines, *with machines now on hand!*

Every Allis-Chalmers man and wo is working *all out* for Victory. Our one right now is winning this war. But from war work we are gaining rich produc experience which will be invaluable to Nation when the war is over. We'l ready to help build a better peace!

ALLIS-CHALMERS MFG. CO., MILWAUKEE,

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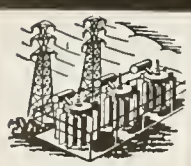
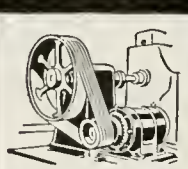
OFFERS EVERY MANUFACTURER EQUIPMENT AND ENGINEERIN



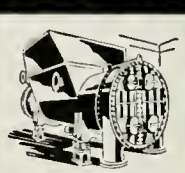
ELECTRICAL EQUIPMENT

STEAM AND HYDRAULIC TURBINES



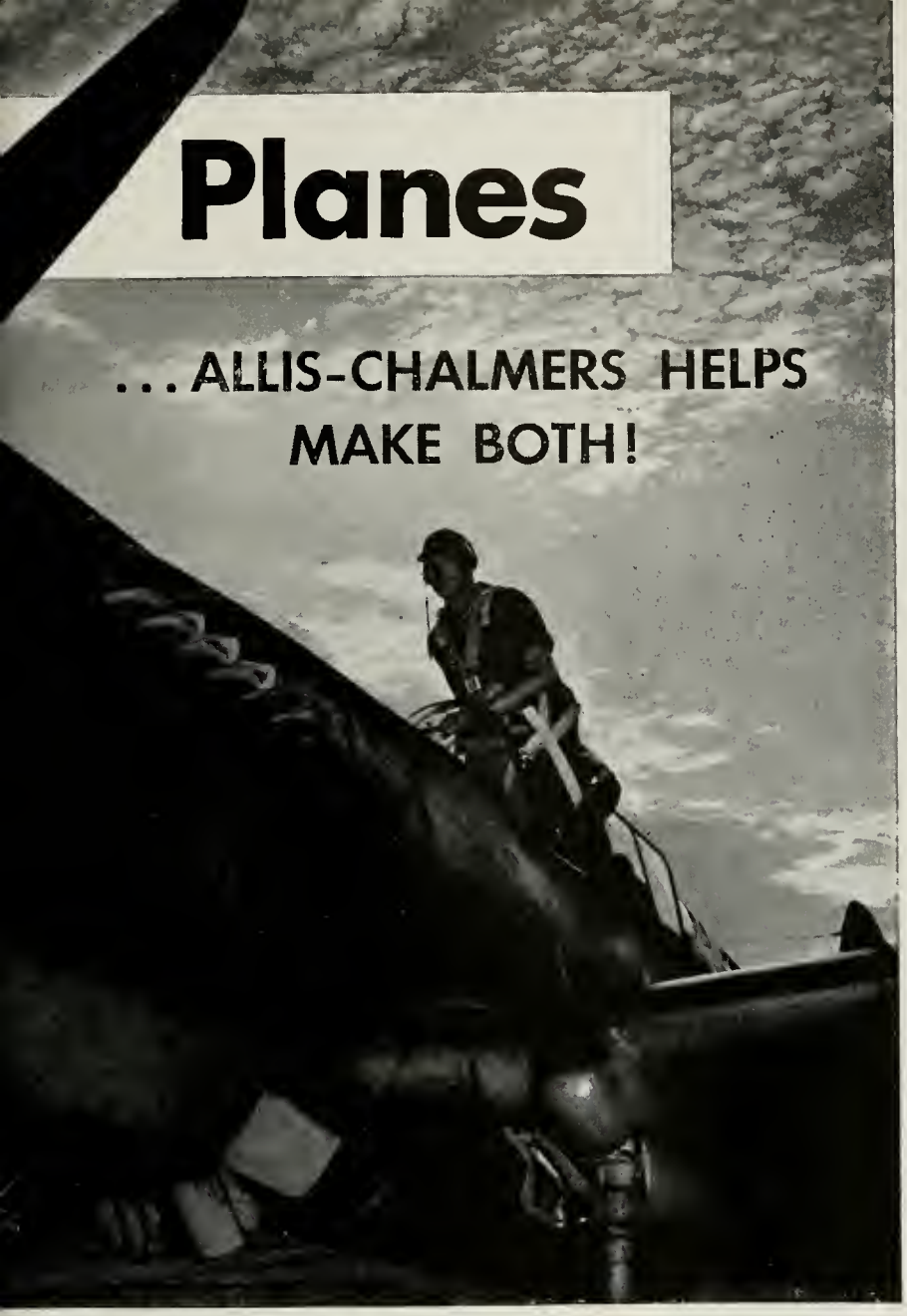
MOTORS & TEXROPE V-BELT DRIVES

BLOWERS AND COMPRESSORS



ENGINES AND CONDENSERS

CENTRIFUG PUMPS



-Chalmers makes the greatest variety apital goods products in the world.

Rubber boats, tires, balloons are made with the aid of Allis-Chalmers equipment.

VICTORY NEWS

Inland Shipyards: Hundreds of A-C pumps, motors and V-belt drives are at work along the Great Lakes helping in the greatest shipbuilding activity this region has ever known.

Ore carriers, tankers, cargo vessels—even submarines—are being built here.

Tremendous expansion of facilities was required to meet the goals set—and equipment for the yards, as well as for the ships, has left A-C plants in great quantities.

YOU'LL WANT THIS HANDBOOK

New 16-Page Book applies to all makes of V-belts—tells how to conserve rubber through correct V-belt maintenance: how to measure proper tension; what determines "life expectancy"; what to do about worn sheaves; much other useful information. Liberally illustrated. Ideal for training new men. Write for your free copy.

New A-C War Plants: Two big new Allis-Chalmers war plants are now in operation "somewhere in the USA"...the second in a record 90 days after the ground was broken.

To save time and critical materials, wood construction was adopted for the newest plant. Practically the only metal used was in caps for the ends of trusses and columns. These were cast in A-C foundries to save time.

FOR VICTORY
Buy United States War Bonds

ALMERS

WE WORK FOR VICTORY — WE PLAN FOR PEACE

ATION TO HELP INCREASE PRODUCTION IN THESE FIELDS...

UR AND SAW
L EQUIPMENT

CHEMICAL PROCESS EQUIPMENT

CRUSHING, CEMENT & MINING MACHINERY

BOILER FEED WATER SERVICE

POWER FARMING MACHINERY

INDUSTRIAL TRACTORS & ROAD MACHINERY

Techniques in Heavy Mineral Separation

(Continued from Page 7)

scope study. Sizes between 35 and 200 mesh are used. Those below 200 mesh are in the silt class and are too fine to be studied, even under the petrographic microscope.

The sample is then acidized in HCL, to remove the Carbonates. As soon as the reaction is completed the sample is washed by filling the beaker with water and stirring the residue. After the residue has settled, the water is poured off, leaving the sand in the bottom. Five or six such washings will give a clean sand. The sand is then dried on a hot plate, or in an oven. To speed up the drying alcohol is added. The sand is now ready for the actual separation.

The liquid used to separate the Heavy Minerals varies according to the user. Bromoform is the most generally used of the separating liquids. Bromoform, (tribrommethane) $CHBr_3$, is a halogen substitution product of methane. It is a highly mobile liquid at ordinary temperature and has a specific gravity of 2.89. An objection to the commercial bromoform however is that due to dissolved alcohol, it is often low in gravity (below 2.89), sometimes below that of quartz. This is undesirable because the presence of quartz would make the separation useless. Quartz is of such abundance in all types and ages of rocks that it is useless as a means of correlation.

Tetrabromoethane (acetylene-tetrabromide)is also very good. It has a specific gravity of 2.96. It, as well as Bromoform however, is mildly toxic if one is exposed to it for a period of time. After working with it for several months at about six hours a day I noticed that the insides of my nostrills were dryed and cracked and bled intermittantly. If one has a ventilating system set up or works with a ventilating hood, little effect will be noticed, however.

Other separatory liquids are:

Methylene Iodide, CH_2I_2, specific gravity, 3.32

Thallous Formate, $TlCO_2H$, specific gravity, 2.89

The separatory liquid is poured into a funnel which has a stop-cock outlet. The sand is then poured into the liquid and is stirred constantly to separate any grains which may adhere to one another.

The minerals which collect at the bottom of the funnel must therefore be of a greater specific gravity than the liquid medium through which they have passed. However, trouble is often encountered at this point by convection currents, thought to be caused by temperature and light which have a marked effect on tetrabromoethane in particular. Therefore, when the stop-cock is opened and the heavy minerals are let down into the beaker below, it is necessary to wait until the tube has cleared completely between the heavy minerals on the bottom and the light minerals floating on the surface.

Quartz whose specific gravity is very close to that of tetrabromoethane, but is not a desirable mineral for correlation purposes and as previously mentioned, is also often found in the finished separation. The reason for this is in part, adherence of the quartz to a larger grain of higher specific gravity. It may usually be removed by a second separation.

The heavy minerals are then washed with acetone to remove the tetrabromoethane and dried.

The tetrabromoethane is recovered by the following process: since it is miscible with acetone, the funnel, both light mineral and heavy minerals, and the beaker, is washed with acetone and the mixture put in a bottle. The bottle is then filled with water and shaken. Since the acetone is more miscible with the water than with tetrabromoethane it and acetone can be poured off leaving the pure liquid once again. This washing process must be done repeatedly until the "tetrabrom" is a clear straw color. The liquid is then poured into a separatory funnel and allowed to settle so that the water left after the acetone and water has poured off may rise to the top of the separatory funnel. Then the liquid is let down into a filter paper to the point just below the water line and allowed to filter through the paper into a beaker. It is then again ready for use.

The heavy minerals are now separated and ready for counting. The first step is mounting them on a slide. The mineral grains are carefully transferred from the beaker to a flat piece of metal with raised sides and tapering toward one end which is left open.

Canada balsam is then placed on a glass slide which is resting on a hot plate and the gum is melted until stage of optimum hardness is reached. The point is determined by touching a dissecting needle to the liquid. If the drop of balsam adhering to the needle hardens immediately and becomes brittle the gum is ready for use. Now the metal container is held over the balsam and by tapping the end the grains will slide out of the opening and drop into the balsam. An even distribution is highly desirable.

A cover glass is then placed over the minerals and pressed down firmly. Care must be taken to avoid trapping air under the cover glass since this will cause bubbles. The balsam will dry very quickly and the slide may be then placed under the microscope.

Microscopic study of the grains will give one the count, size and shape which is needed. As many as 500 grains are counted on a single slide. The type of microscope used is a petrographic microscope which has in addition to the ordinary enlargement powers two lenses or nicols which separate out the rays of light.

On a typical St. Peter SS. slide, the following minerals might be observed:

Count:	Zircon	46
	Tourmaline	62
	Garnet	1
	Leucoxene	11
	Augite	14
	Ilmenite	5

The criteria used in determining these grains are as follows:

A. Index of refraction of the grain.

B. Extinction angle, that is, the angle at which the grain cannot be seen at all when the stage of microscope is rotated.

C. The color of the grain. A mineral absorbs certain wave lengths — transmits or reflects others — the thickness affects the color.

D. Pleochroism is selective absorbtion, that is, when the stage is revolved, sometimes the color of the grain will change.

E. Relief.

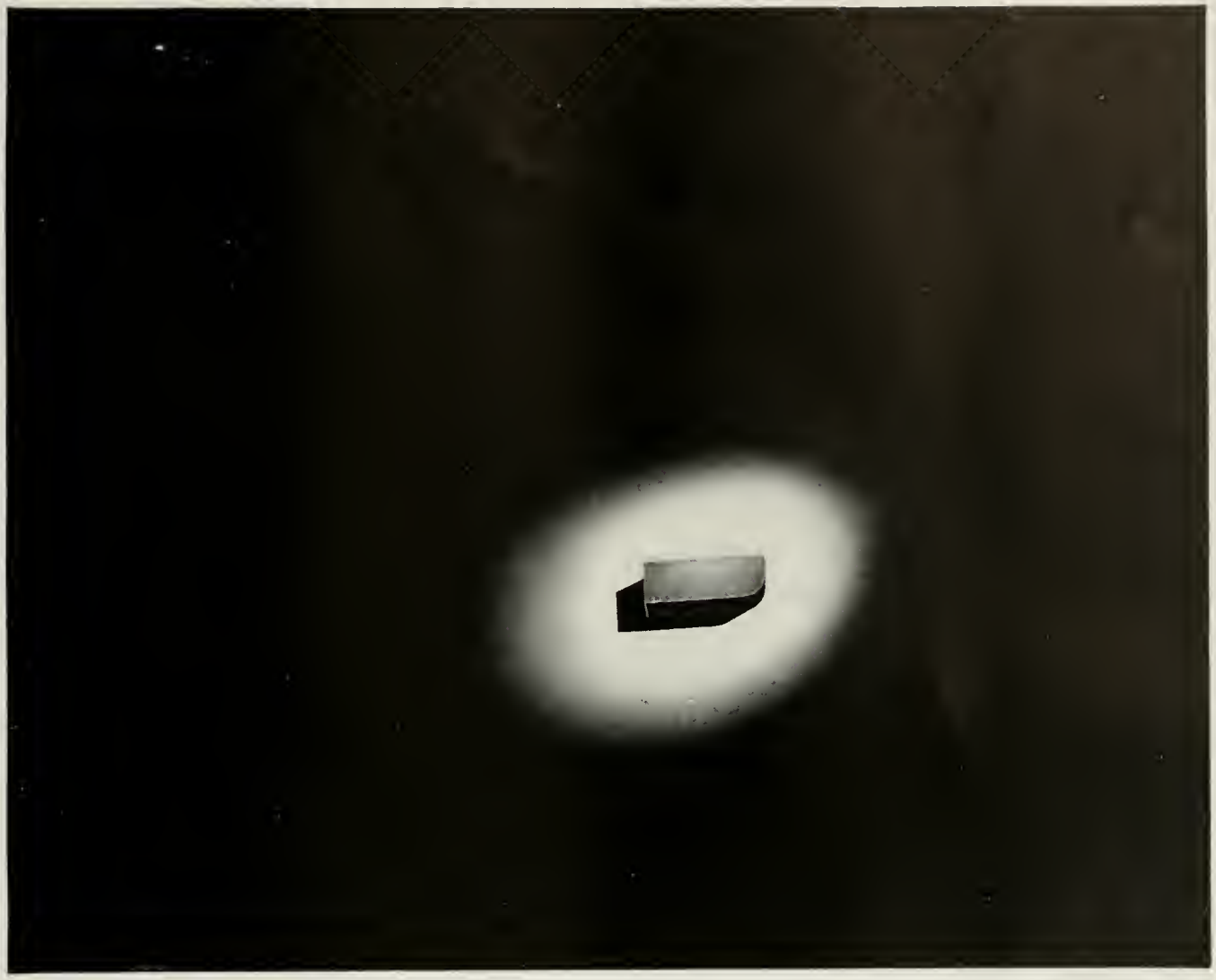
If a certain grain is under the eye of the observer he would look for the above mentioned things.

An illustration of this is zircon. Zircon has the following formula:

Sign, Tetragonal-prisms with pyramids, 110 cleavage 111 index: Epsilon = 1.985; Omega = 1.936; specific gravity 4.6—4.7; Chemical formula $ZrO_2:SiO_2$; Color, colorless—sometimes mauve, yellow to brown. If strongly colored, will be pleochroic.

Note—high index of refraction causes a heavy dark band

(Continued on Page 22)



"METALLIC VITAMINS" FOR INDUSTRY

So effective are relatively minute quantities of cemented carbides in stepping up—pepping up—production that they are often called the "metallic vitamins" of industry.

Because only small quantities are required per tool, Carboloy cemented carbides are measured in grams. A gram is 1/453rd part of a pound. A Carboloy tool tip weighing only 25 grams or slightly less than one *ounce* is a good size tip—enough to last for days, weeks—often months of cutting at speeds often higher than 4 to 5 times that possible with ordinary steel tools.

In terms of production, an ounce of cemented carbide can turn the turrets of dozens of tanks, or drill hundreds of guns, or turn as many as several hundred shell, or bore the cylinders of hundreds of "Jeep" cars. One ounce of carbide can do these and countless other crucial machining jobs faster and better than any other tool material.

These "metallic vitamins" also serve the cause of victory in many other ways. In masonry drills, they drill holes in concrete 75% faster for installing war production machinery. . . . In dies they speed up production of wire, cartridge cases, bullets, etc. . . . As wear-resistant inserts on vital machine parts, they keep machines running. As a matrix material, they conserve diamonds, shorten operating time on mine drilling, dressing of grinding wheels, etc.

The myriad of present uses for Carboloy—the "metallic vitamin" of industry—now helping to speed the day of victory, forecast the steadily increasing diversity of benefits for the years of peace to come. ★ ★ Carboloy Company, Inc., Detroit, Mich. District Offices: Birmingham, Ala. • Chicago • Cleveland • Los Angeles • Newark • Philadelphia • Pittsburgh • Seattle.

CARBOLOY TRAINING FILMS

A series of six Carboloy Training Films now available covering detailed, step-by-step procedure on the design, brazing, grinding, use and manufacture of cemented carbide tools, 35 mm silent slide films. (Not motion pictures.) Available for permanent use at approximate print cost of $20 per set. Educational institutions may also secure sets on loan for single showings through selected college film loan libraries. Catalog and loan library listing on request. Write Carboloy Company Inc., Detroit, for Booklet "A".

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TODAY DEMANDS PRODUCTION *AND* ACCURACY
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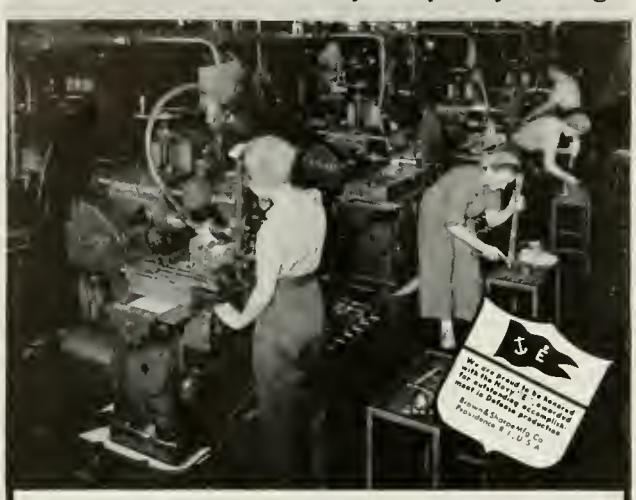


✓ Automatic Milling Cycles
✓ Climb or Conventional Milling
✓ Ease of Set-up and Operation
✓ Electrical Control
— and many other advantages to mill efficiently on a wide variety of materials

B·S
Brown & Sharpe Mfg. Co.
Providence, R. I., U. S. A.

BROWN & SHARPE

NAMES IN THE NEWS

(Continued from Page 10)

sometimes he likes to go out with the fellows in his house and have a good time. He also likes to participate in such sports as baseball, soccer and basketball.

Some day, Dale hopes to settle down on a nice modern improved farm and practice agricultural engineering. Dale has done all right for himself as shown by his good scholastic average of 4.1. When asked why he chose Illinois as his school, Dale replied, "Illinois was the best all-around engineering school I knew, and a person from Illinois had the reputation of being well qualified.

BOB WHITAKER

From the record of his results, we can see that Bob Whitaker has achieved the goals he once established. He is president of the A.S.Ag.E., as well as being a representative on the Agriculture council and the Engineering council. In addition, he is a member of Sigma Tau and Alpha Zeta.

Whenever Bob can find the opportunity, he participates in track and basket-ball. But this does not eliminate his hobby of dating and attending the various church parties.

Although his major is Agricultural engineering, Bob has especially liked T.A.M. and C. E. courses. He received quite a kick out of these courses and he has also done very well in them as shown by his good scholastic average of 4.6. After leaving his home town of Forest City, Illinois, where he had proved himself, he came on to Illinois and has since done a good job of making himself respected and liked.

Bob is preparing himself for an active military career.

BOB

He is a member of the Corps of Engineers advanced ROTC. He has already spent one summer at a training camp, so Bob expects to be commissioned a 2nd. Lieutenant in June.

ALLAN PARK

One of the most active of the fraternity engineers is Allan Park. He is a member of Zeta Psi and is greatly interested in all fraternity work. He was a member of the Illio business staff for two years, and also is senior manager of swimming. He is a member of Dolphins, swimming honorary.

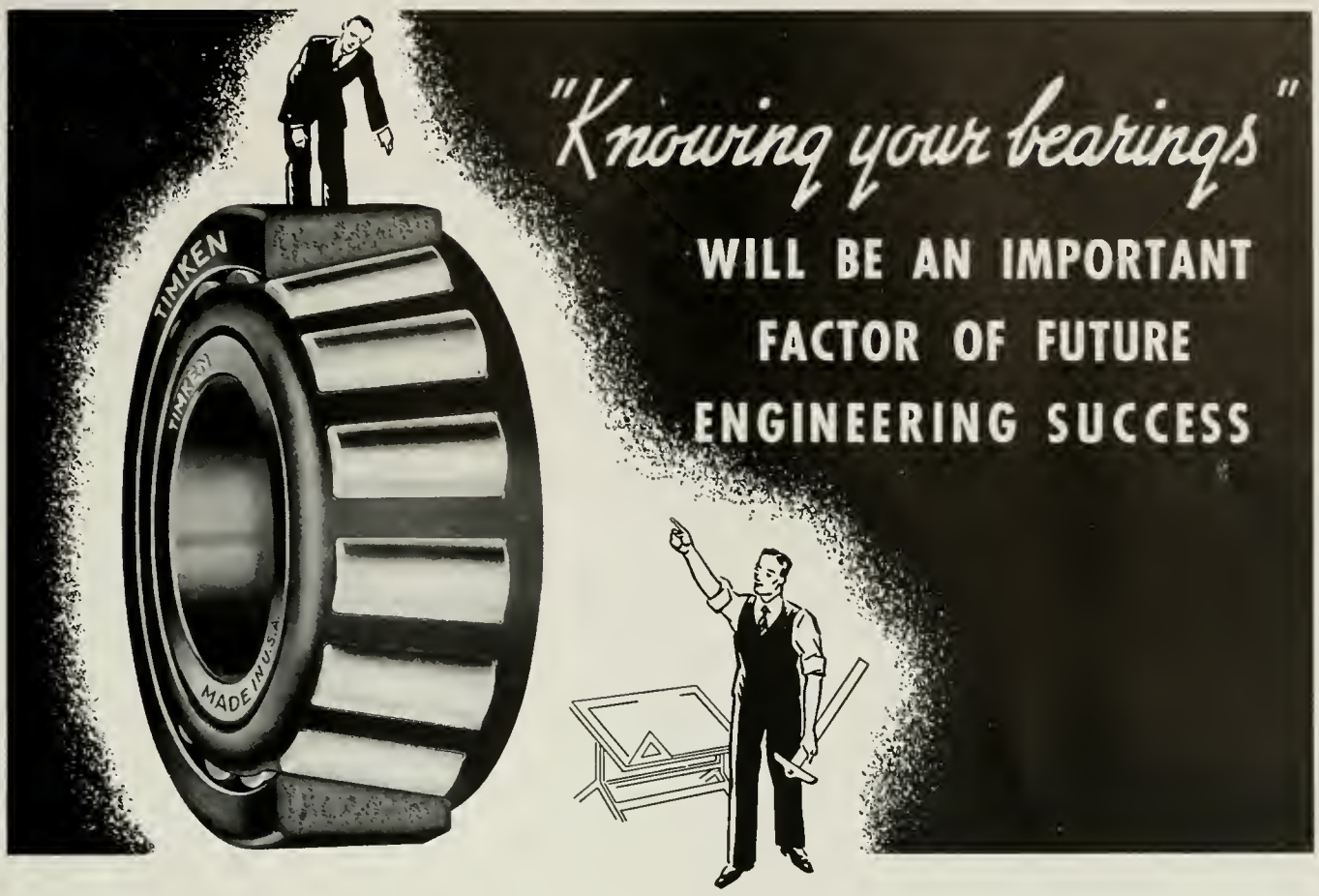
Allan has also been quite interested in intramural sports. He and Dale Hankins won the doubles championship in badminton. He is also skilled in squash, tennis, ping pong, and baseball.

Moline, Illinois claims this mechanical engineer as its son and is justly proud of him. When he graduates, Allan

ALLAN

is all set to take a position with Curtis Wright. There he expects to test airplane engines.

As might be expected, Allan is quite interested in dynamics, and internal combustion engines. One of his favorite courses that has helped contribute to his good 3.94 scholastic average is psychology. He says that he really received a kick out of that course. Because Illinois held a reputation of being superior in mechanical engineering, Allan naturally came to Illinois.



The terrific strain of modern war is testing American mechanical equipment of all kinds as it never has been tested before, but it is coming through with flying colors.

For, among other vitally important things, the designers of this equipment *know their bearings;* that is why so many Timken Tapered Roller Bearings are used in tanks, trucks, armored cars, guns, airplanes, warships and the machines that make them. Timken Bearings meet every bearing requirement because, in addition to eliminating friction they carry radial, thrust and combined loads and hold moving parts in correct and constant alignment.

Timken Roller Bearings have been solving bearing problems in industrial and transportation equipment for many years—long before the first world war. They will be called upon more and more during the reconstruction period that will follow Victory for the United Nations in the present conflict.

That is why you should begin now to acquire a thorough knowledge of Timken Tapered Roller Bearings — their design and application. When you have this knowledge you will be able successfully to meet any bearing condition you ever may encounter. Our engineers will help you to get it. The Timken Roller Bearing Company, Canton, Ohio.

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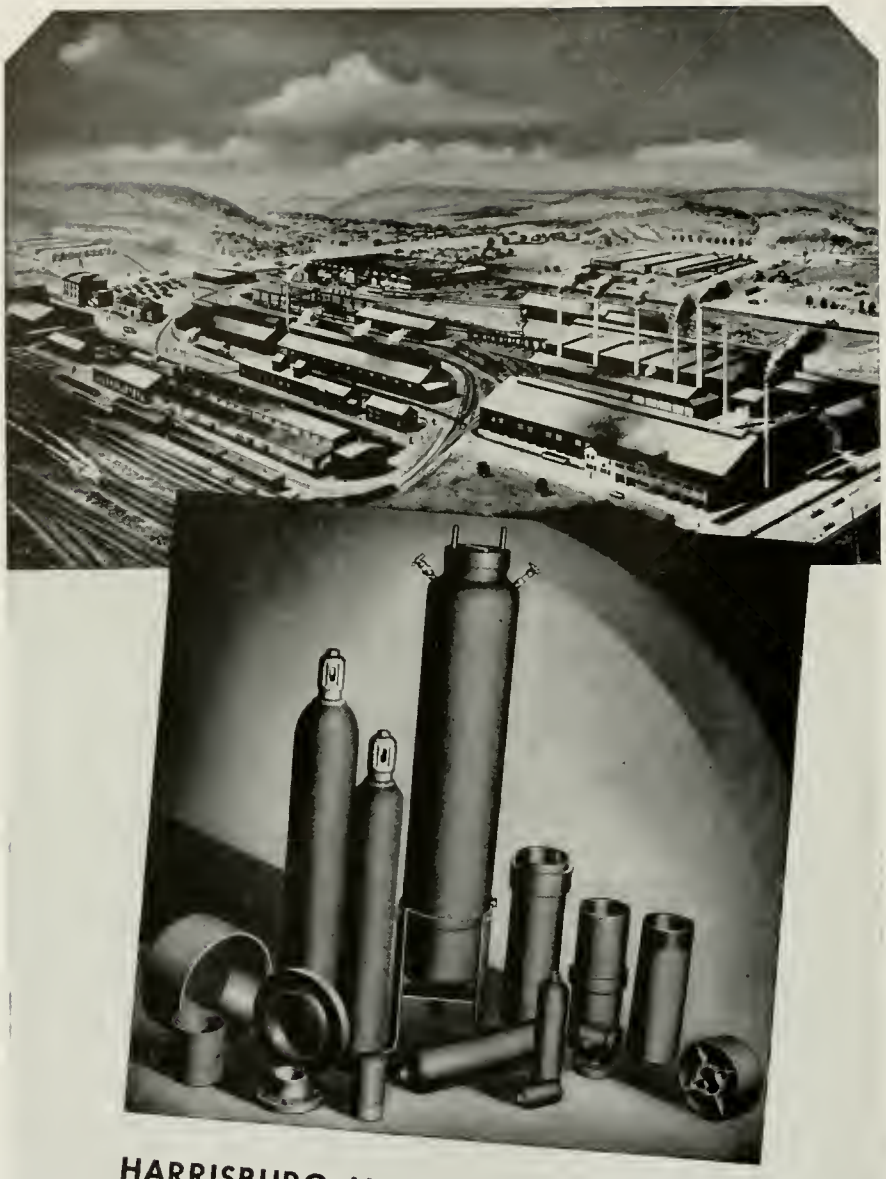
TAPERED ROLLER BEARINGS

Manufacturers of Timken Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; Timken Alloy Steels and Carbon and Alloy Seamless Tubing; and Timken Rock Bits.



HARRISBURG MAKES . . . Alloy and Carbon Steel Billets: Seamless Steel Cylinders, Liquefiers, Pipe Couplings and Pump Liners: Hollow and Drop Forgings: Pipe Flange: Coils and Bends.

THIS 102-PAGE CATALOG IS FREE. SEND FOR IT . . . Contains official S. A. E. Standard Specifications; information on Cylinders, Flanges, Couplings, Pump Liners: up-to-date data on the Liquefier. Well illustrated. An important reference book to have in your possession.

ARMY E NAVY

HARRISBURG STEEL CORPORATION

HARRISBURG, PENNSYLVANIA

Coordinating Power Systems

The Westinghouse a-c calculating board is constantly engaged these days. The need for co-ordinating power systems throughout the country, together with the need to squeeze every available kw from existing facilities to speed the war job, brings engineers from all parts of the country to East Pittsburgh to work out their problems.

Tank Fires Gun While in Position

The M-4 tank was the first to carry a device, developed by Westinghouse engineers, which is said to improve the accuracy of gunfire by more than 500 per cent. According to General Campbell, the 78 mm gun can be fired when the tank is in motion. Enemy tanks, regardless of size, cannot do this.

Cotton Belt Splice Now Satisfactory

Splices in cotton belts have never been satisfactory for high-speed power transmission applications. The leather shortage has resulted in the development of a new waterproof cement which, according to Westinghouse experts, makes a smooth, permanent splice.

Fluoreseent Buoy Guides Sea Planes

The Navy uses a new doughnut-shaped rubber buoy with a fluorescent lamp mounted on top to guide seaplanes to their birth, Westinghouse engineers point out. The lamp operates at 45 volts, thereby eliminating the insulation difficulties formerly experienced in the salt water atmosphere when a potential of 3000 volts was used.

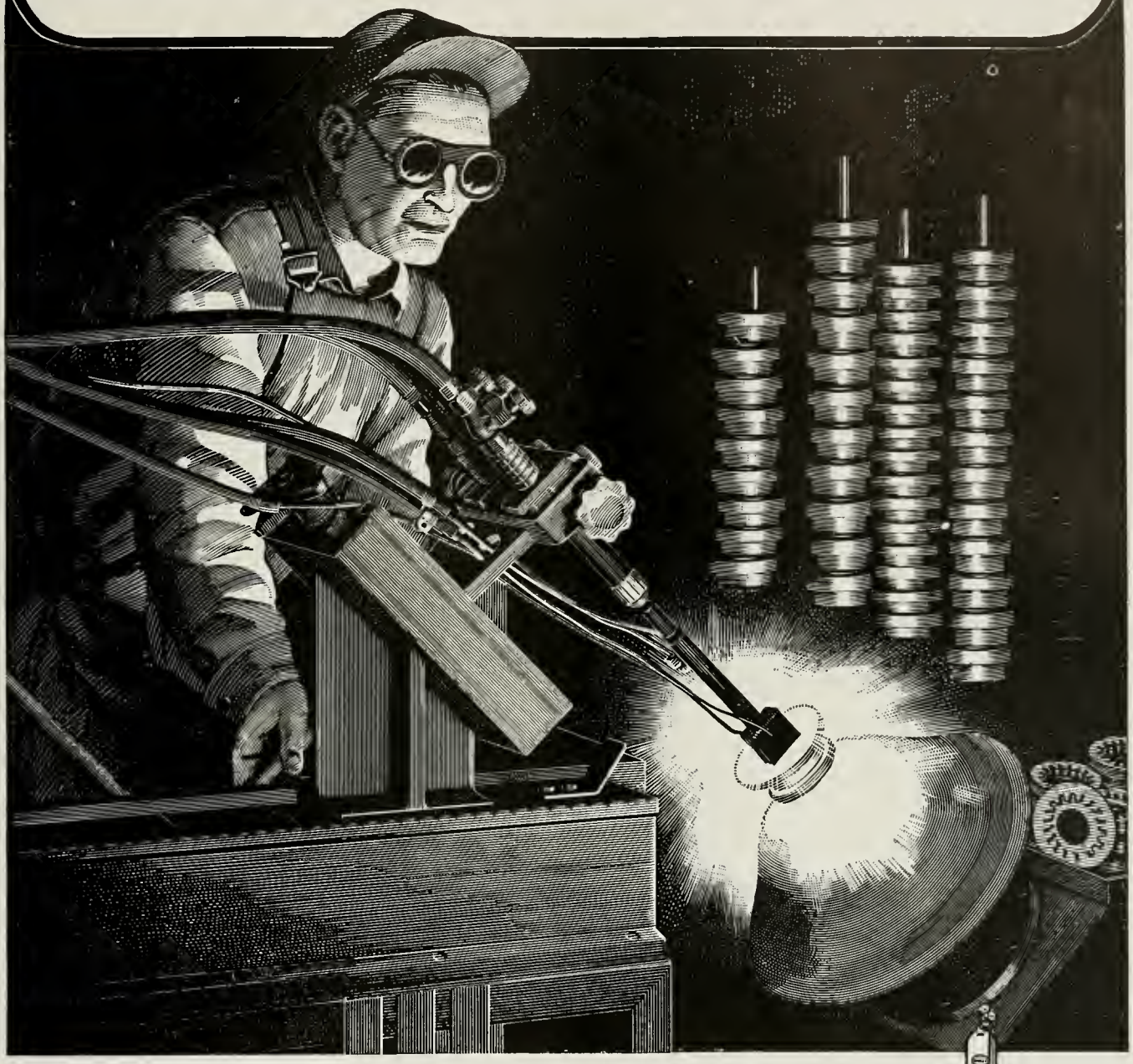
Bombers Carry Extra Gas Tanks on Long Flights

Thin-walled aluminum tanks, riveted and welded at the seams to make them leak-proof, are carried as extra fuel tanks by our bombers on long flights. According to Westinghouse experts the tanks occupy space where bombs are usually carried. The extra tanks are drained first and then are dropped from the plane to lighten the load.

Paek Radio Serves Army and Navy

A two way radio weighing only 32 pounds has been developed for the armed forces, Westinghouse engineers point out. Carried on a mans back and having a range of 10 miles in daytime, it has proved useful not only on land but also at sea. Ships in a convoy can hear the signals but they fade out before reaching enemy ears.

GEAR TEETH HARDENED IN 8 SECONDS



IN only a few seconds the oxyacetylene flame adds greatly to the service life of this internal gear. Teeth and other surfaces subject to wear are rapidly hardened by the modern oxyacetylene flame treating process. The depth of hardening is easily and accurately controlled, without affecting the inherent toughness of the core metal.

Airco Flame Hardening gives all the advantages of other surface hardening methods plus speed and ease of application. Simple arrangements using one or more torches permit flame hardening of a large variety of metal parts on a production basis.

Many other applications of the oxyacetylene flame are finding ever widening application in speeding and improving production of ships, tanks, guns, rolling stock and planes. This versatile tool slices through steel with remarkable speed—welds metal into strong, light units—sweeps surface rust from metal structures to extend the life of paint jobs—gouges steel and iron quickly and accurately.

To better acquaint you with the many things that this modern production tool does better we have published "Airco in the News", a pictorial review in book form. Write for a copy.

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ANYTHING AND EVERYTHING FOR GAS WELDING OR CUTTING AND ARC WELDING

Our Societies . . .

By BYRON ROBINSON, M.E. '44

A.I.Ch.E.

On February 17, a meeting of the A.I.Ch.E. was held to discuss plans for the new semester. The date for the Chem. Engineers' banquet has been set, tentatively, for March 17. Dr. D. B. Keyes will be the chief speaker for the evening. Also, the U. of I. winner of the Senior Chem. Engineer design problem will be honored. This is an A.I.Ch.E. design problem, and the Senior Chem. Engineers of many colleges over the United States are competing. The problem this year is a design and technical problem on the production of Magnesium. So far, the U. of I. has won more of these competitions than any other school.

SIGMA TAU

At a meeting on February 15, 1943, Sigma Tau elected the following officers to serve for the second semester 1942-43:

Gordon McClure ..... *President*
Nathan Schwartz ..... *Vice-President*
Eugene Beirman ..... *Treasurer*
Harold Schick ..... *Corresponding Secretary*
Pete Fenoglio ..... *Recording Secretary*

A.I.E.E.

At the first meeting of the A.I.E.E. of the new semester, Dr. C. F. Hottes, Professor of Plant Physiology, Emeritus, presented pictures of his travels, and gave an interesting travelogue in his comments on his pictures. On March 23, 24, or 25, E. U. Condon, Assistant Director of Research of Westinghouse Electrical Manufacturing company, will give a talk on micro-wave electronics. Mr. Gordon has been very highly rated as a speaker, and since his talk is to be on a very new and interesting subject, the A.I.E.E. invites all those who might be interested to come. The meeting will be in 215 E.E. Lab., and the exact date will be announced later.

PI TAU SIGMA

Pi Tau Sigma selected the following men to lead their organization for the second semester 1942-43 at a meeting held February 16, 1943:

Bill Mareneck ..... *President*
Steve Yurenka ..... *Vice-President*
Paul Salerno ..... *Treasurer*
Hector Aiken ..... *Corresponding Secretary*
Bill Owen ..... *Recording-Secretary*

TAU NU TAU

T.N.T. held a short business and organization meeting on February 16, at which plans for the year were discussed. A rushing smoker has been planned for February 23, and a series of pledge meetings on March 2, 9, and 16, have also been planned. These rushing meetings will be followed by initiation of those "sappers" who successfully undergo their pledge period. After the initiation, a dance has been planned in honor of the new initiated, but no date has been set for this event.

This year, all new members of T.N.T. will automatically become members of The Society of American Military Engineers, of which T.N.T. is a student branch. Also, the new members will receive the society's publication, "The Military Engineer." This magazine is very interesting and informative, and will be of great value to all those interested in modern military engineering. Copies of this magazine can be found in the Engineering library.

A.S.A.E.

During Farm and Home Week, February 3, 4, and 5, the Agricultural Engineers laid aside their slip-sticks and moment tables and donned aprons to operate their annual "beanery", the profits from which are used to send members to various A.S.A.E. meetings throughout the nation. The patrons were well satisfied with the culinary skill of the boys from North campus, and as yet, no reports of ptomaine poisoning or other digestive complications have been received.

"Zeke" Reeser and Bob McMaster, with their enthusiastic attacks on the hamburger supply apparently convinced the visitors that the food was really good, because the crowd of customers was almost more than ten husky Ag. Engineers could handle.

On February 16, Professor Crandell of the Civil Engineering spoke on "Mud Houses for the Multitudes"—a discussion of the manufacture and utilization of stabilized soils.

NOTE: An unintentional mistake in the January "Technograph" was the naming of Donald Hamer as Scribe of the A.S.A.E. The newly elected Scribe is John Cress.

S.B.A.C.S.

At a special meeting held February 17, 1943, S.B.A.C.S. members heard two short addresses on problems of two branches of the ceramic industry. Mr. S. A. Peterson, Head of Enamel Research at the U. of I., spoke on problems of the enamel engineer, and Mr. C. R. Fillipe, instructor in Ceramics spoke on structural clay products. Any member may present a paper on a technical subject. Other plans for this semester include a picnic to be held in the spring.

KERAMOS

On January 20, Keramos elected officers for the second semester, 1942-43. They are as follows:

Vaughn Seitzinger ..... *President*
Payson Shonkwiler ..... *Vice-President*
Jack Peterson ..... *Secretary-Treasurer*
Bill Prentice ..... *Herald*
Earl Smith ..... *Senior Class Secretary*

CHI EPSILON

On January 17, 1943, the new officers of Chi Epsilon were installed at the home of Professor W. A. Oliver, chapter advisor.

Your future is not forgotten

★ A MESSAGE TO MEN IN COLLEGE

There will be a future.

The very service you are being called upon to render to your country is assurance of that. We know the stuff you're made of, because we have watched two generations of college men join our ranks and grow with us.

And the materiel which we older men in industry are pouring out makes assurance doubly sure.

What kind of future will you have?

By chapter and verse, no one can recite *exactly*. But a lot of folks like us mean to see that Opportunity is going to be greater than any generation of young men has ever known.

Every hour of thinking time we can catch on the fly is devoted to that one aim. Here at Alcoa we call it Imagineering. We are letting our imagination soar, and ballasting it with engineering experience. Our purpose is to make aluminum make jobs where none ever existed before.

The exciting new uses we glimpse for Alcoa Aluminum are our part of the groundwork of the structure of peace you will come back to help to build.

Your chance is going to be the creative chance. The materials, the tools, the techniques, will be ready and waiting. Your imagination, your ingenuity, your courage to do, cannot, must not, fail to have their turn.

As man to man we say it, soberly: Your future is not forgotten.

A PARENTHETICAL ASIDE: FROM THE AUTOBIOGRAPHY OF

ALCOA ALUMINUM

• This message is printed by Aluminum Company of America to help people to understand *what we do* and *what sort of men* make aluminum grow in usefulness.

TECHNOCRACKED . . .

By PAUL SALERNO, M. E. '43

A soldier returned to camp with a Japanese helmet slung over his shoulder. "I had to kill a hundred Japs to get this," he told his pals.

"How come?" they asked.

"Had to get the right size," he said.

* * * *

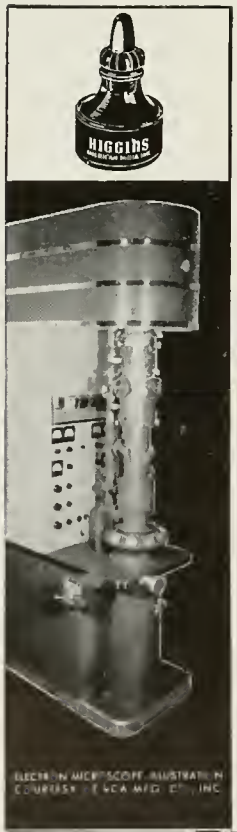
It seems that the shoe ration coupons are interchangable among members of a family. The head of the house will soon be singing "Dad's old fashioned footgear."

* * * *

A man's death notice was inserted in a newspaper by mistake and naturally he was very much concerned about it. In a fine state of rage, he phoned the death notice editor.

"Say, bud," he said, "did you put my death notice in your paper."

"Why, yes," answered the editor, warily. "By the way . . . er . . . where are you calling from?"



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AVAILABLE IN A COMPLETE COLOR RANGE

HIGGINS INK CO., INC.
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A buck private—newly inducted—walked past a looey without saluting. The officer called the rookie back and, pointing to his shoulder, he asked, "Do you see that?"

"You shouldn't complain," the private answered, "Look at the suit they gave me."

* * * *

From the deep south comes this tale about two colored men named Mose and Sambo (as usual).

They were strolling along a highway when Mose found a beautiful wrist watch. He put it on his wrist with a visible show of pride although neither one could tell time.

After a while Sambo asked, "What time is it, Mose?"

Mose put out his arm and said, "Dear she am."

Sambo looked down carefully and said, "Damned if she ain't."

* * * *

A young man went into a drug store and asked, "How's the ice cream?"

The clerk answered, "As pure as the girl of your dreams."

"Gimme a pack of cigarettes, willya," the youth answered.

* * * *

Another of those two lunatics gags.

"What have I got here," said one, with his hands cupped.

"A squadron of B-17's?" answered the second.

The first peeked carefully into his hands. "Nope."

"The Empire State Building?"

"Nope."

"The Philadelphia Symphony Orchestra?"

The other looked into his hands again and said shyly, "Who's conducting?"

HEAVY MINERAL SEPARATION

(Continued from Page 14)

to be seen under plane polaried light. This is due to the fact that Zircon, having an index of refraction of about 1.930 is considerably greater than the balsam medium in which the grain is mounted. (Balsam, 1.536). The light rays are highly refracted allowing few of them to go up the tube of the microscope. Therefore, those which do not go directly up the tube cause a dark band to appear around the grain. Note—Zircon has complete and parallel extinction in white light. The extinction is parallel to the C axis.

Heavy mineral separations as a means of correlation are often used as the only criteria for tentatively differentiating sandstones. This should be of special interest to any engineers interested in water supply since it is the sandstones that carry the subsurface waters.

. . . and we made a Sapphire!

YOU'RE LOOKING at a sapphire being made in the incandescent heat of a specially designed furnace... a synthetic sapphire . . . better than the natural gem. It takes hours to grow one of these sapphire boules.

What's so wonderful about it? Sapphire is necessary for the security of this country. Out of this jewel stone are made hard, long-wearing bearings for precision instruments. The various precision devices of a modern battleship require more than 4,000 jewels: about 100 more are needed in fire-control mechanisms. Modern pursuit planes and bombers require up to 100 sapphire bearings in their instruments.

In 1940, this country was completely dependent upon Europe for sapphire jewels. The call went out for American-made sapphire to meet this nation's needs.

Because we at Linde are experienced in the production of gases and in the accurate control of high temperature gas flames, we volunteered to try to make sapphire. After two years of experimental research, we learned how to produce the high-purity raw materials needed and also how to make sapphire from those materials. Today, we make more synthetic sapphire than this country ever imported from Europe . . . enough to meet all industrial and military needs. Thus America need never again be dependent upon an outside source.

Right now, we make colorless sapphire because colorless jewels make harder bearings. No sapphire is available for anything but war production. In the future we stand ready to make ruby and other gem stone materials for the jewelry trade . . . and for you.

This research development by The Linde Air Products Company is paralleled by other recent achievements of Electro Metallurgical Company, Carbide and Carbon Chemicals Corporation, and National Carbon Company, Inc.—all of which are Units of Union Carbide and Carbon Corporation.

THE LINDE AIR PRODUCTS COMPANY
Unit of Union Carbide and Carbon Corporation
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GENERAL OFFICES: NEW YORK, N. Y.
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HIS BEARINGS ARE RIGHT—Chronometers, compasses, and other navigational aids must be rugged as well as precise. Sapphire bearings can "take it."

FLYING JEWELS—Pilots' lives and the success of their missions depend upon accurate instruments. Sapphire bearings assure continued accuracy.

LABORATORY WARRIORS—Delicate balances, time instruments, and other important precision equipment of the research worker need sapphire jewels, too.

YOURS IN THE FUTURE—Flawless gems...such as rubies, sapphires, and spinel . . . made by this same Linde process . . . will be available for jewelry in the future.

BUY UNITED STATES WAR BONDS AND STAMPS

G-E Campus News

MERRY-GO-WHEEL

A DEVICE that rotates in the manner of a combination merry-go-round and Ferris wheel has been developed to speed the drilling of marine gear casings at one of General Electric's major plants.

Known as a universal indexing trunnion fixture, the device permits quick moving of the casings for drilling at any angle in a full circle and on any plane. Movement is controlled by a push-button.

About 110 holes must be drilled and tapped in each of the casings. Formerly it took a crane to move the casings (which vary in weight from 1000 to 2000 lb) after each surface was drilled, and every piece of work had to be set up at least six times.

Now work is set up just once—on a table that can be turned completely around in either direction with no more effort than it takes to push a revolving door—and 24 to 32 hours a week are saved.

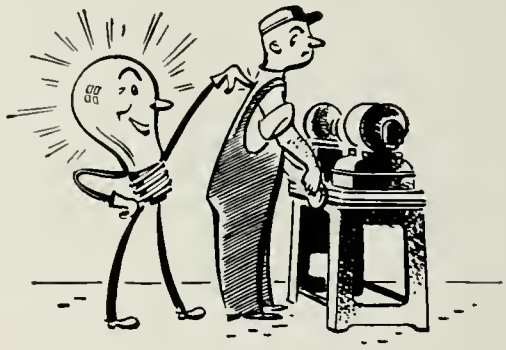
THE BETTER TO SEE WITH

PARTICLES as small as one millionth of an inch—one thousandth of the diameter of a human hair—can be clearly seen with the new G-E electron microscope.

Developed by Drs. C. H. Bachman (Iowa Srate, '32) and Simon Ramo (U. of Urah, '33), the new instrument can magnify a specimen as much as 10,000 times and reveal the actual composition and structure of such minute things as dust and smoke particles.

Here's how it works: a beam of electrons inside a vacuum chamber passes through the specimen, passes through an "electron lens," and produces a magnified picture on a fluorescent view screen. This image can then be photographed outside the tube and enlarged up to 100,000 times the size of the original specimen.

The microscope, designed for use in small laboratories and war plants, is portable and operates on ordinary house current.



THE LIGHT FANTASTIC

ACTUALLY it's just an ordinary light bulb, but used in an indicating method developed by a G-E foreman, it helps minimize errors in precision lathe work requiring an accuracy of five one hundred thousandths of an inch.

This new method eliminates the human element inherent in the old practice of using a magnifying glass to see when the tool makes contact with the surface to be cut.

In this indicating method, electrical contact between tool and work is used to close a light circuit. The tool is brought up to the surface to be cut in the regular manner until it is just about to make contact. From this point on it is brought up very slowly until the pilot light flickers.

When the light is steady, the indicator is set at zero; and if it is set and read correctly, there can be no error.

If you'd like to try this on your own machine-shop equipment, write for a free diagram and description to Campus News, General Electric Co., Schenectady, N. Y.

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FROST HEAVING

AFTER THE PEACE

NAMES IN THE NEWS

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The private war of 王兆振

DR. CHAO-CHEN WANG carries a slide rule instead of a rifle. Logarithms are his bullets. Differential equations, his high explosives.

Yet he's waging just as deadly a war, against the hated Japs, as any of his brave compatriots in far off China.

For his is a war of electronics at work!

Since joining Westinghouse last summer, this young Chinese scientist has made several important contributions in the field of electronics design.

One of them—*a new method for measuring the output of ultra high frequency radio tubes*—may prove as valuable to the United Nations as a million machine-gun bullets fired at the enemy!

Dr. Wang is an expert in the mathematics of ultra high frequency communications. He does his "Jap fighting" in one of the Westinghouse Electronics Laboratories.

Here he employs his special genius in calculating — in advance — the performance and characteristics of electronic tubes *before* they actually take form.

★ ★ ★

DR. WANG, and other young engineers who enter our employ every year, are constantly contributing to the "know how" of the Westinghouse organization.

Westinghouse believes in helping young engineers grow and advance as rapidly as possible—for upon these scientists of tomorrow our whole future depends.

Westinghouse Electric & Manufacturing Company, Pittsburgh, Pennsylvania.

TUNE IN the Westinghouse Program starring John Charles Thomas—NBC Network, Sunday, 2:30 P. M., Eastern War Time.

DR. CHAO-CHEN WANG studied electrical engineering at Chiaotung University in Shanghai. He was sent to Harvard University by the Chinese Government where he specialized in ultra high frequency communications. Before joining Westinghouse, he received his M. S., in 1938, and his Ph. D., in 1940.

Westinghouse

PLANTS IN 25 CITIES—OFFICES EVERYWHERE

MARCH ★ 1943

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Published Eight Times Yearly by the Students of the College of Engineering, University of Illinois

Published eight times during the year (October, November, December, January, February, March, April, and May) by The Illini Publishing Company. Entered as second class matter, October 30, 1921, at the post office of Urbana, Illinois. Office 213 Engineering Hall, Urbana, Illinois. Subscriptions, $1.00 per year. Single copy 20 cents.

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Frontispiece . . .

Their clean lines and flowing surfaces suggest the controlled power of these Hydro-generators.

— Courtesy Westinghouse.

★

Cover . . .

Another example of the changes brought about in war time was the arrival of a group of girls on the engineering campus. They are taking a survey engineering course connected with the civil service.

Our Electron Microscope

By PAUL SALERNO, M.E. '43

The development of the electron microscope has been the greatest single advance in the field of microscopy since Leeuwenhoek discovered the compound microscope in the latter part of the seventeenth century.

The best optical microscope of today will not show detail of an object smaller than 2000 Angstrom units (1.8×10^{-6} inches). This is due to the fact that the theoretical limit of resolution of a microscope is one-half of the wave length of light. In other words, light will pass around an object which is smaller than one-half wave length. Ultra-violet light, which is of shorter wave-length than ordinary, has been used and has extended the limit of resolution to about 1000 Angstroms.

In 1924, a French physicist, Louis de Broglie, proposed that a stream of electrons possessed wave-like characteristics. After this announcement, which was based on theoretical considerations, Davisson and Germer (in 1927), of the Bell Telephone Company, proved experimentally that a moving electron has a wave motion associated with it. The wave-length was determined and found to be

$$\lambda = 12.24\ V^{-\frac{1}{2}} \times 1\ 10^{-8}\ cm$$

in which V is the voltage which accelerates the electron. Since very early experimenters, including Sir William Crookes, had discovered that a stream of electrons could be deflected or bent by means of an electro-magnetic field, scientists wondered if electrons, with their extremely short wave-length, might not be used to examine much smaller objects than were visible under an ordinary microscope.

The modern electron microscope has made this possible. In this instrument the path of electrons is exactly similar to the path of light in the optical instruments. Instead of

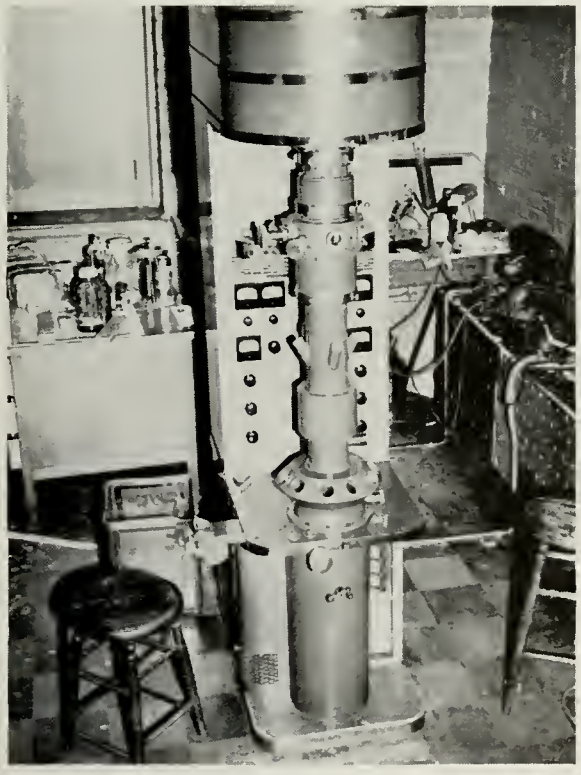

Figure 1. The electron microscope located in the Noyes Laboratory.

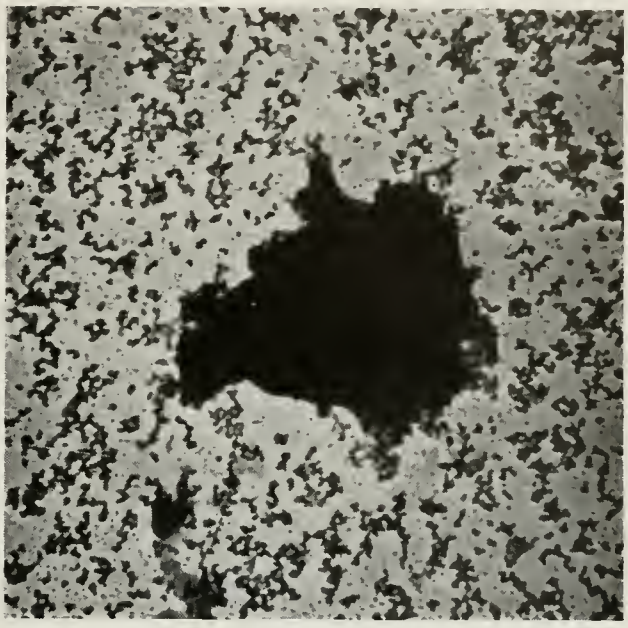

Figure 2. A photograph of finely-divided lime particles. The magnification of the original photograph was to 100,000 diameters.

lenses, however, the electron microscope uses coils of wire which create a magnetic field. The electrons originate from a hot tungsten filament which is located near the top of the instrument. Accelerated by a potential of 60,000 volts, they are focused on the specimen by a magnetic condenser "lens". After passing through the specimen, they are picked up by another lens", which corresponds to the objective in the optical counterpart of this instrument. The final image is formed by a third magnetic coil or eyepiece. Since electrons are invisible, they are allowed to fall on a flourescent screen which converts the electron image into a light image. The image is focused by varying the intensity of the magnetic fields. The magnification on the fluorescent screen or the photographic plate located directly below it, is about 25,000 diameters. The usual practice is to enlarge the photograph and obtain magnifications of 90,000 to 100,000 diameters. Distortion of the final image is prevented by keeping the accelerating voltage and magnetizing currents at a constant value. In the RCA instruments, these are held to within .01 per cent. It is easy to see the effects of a change in voltage. This would cause a change in the electron velocity and would cause a blurred image, just as a chromatic aberration blurrs the image in an ordinary microscope. Variations of current in the magnetic coils would produce distortion similar to that caused by spherical aberration in a glass lens.

In order that the motion of the electrons will not be hindered by collision with relatively heavy gas molecules, the microscope chamber is almost completely evacuated. The pressure is about $1\ 10^{-5}$ millimeters of mercury. The instrument is provided with two ingenious airlocks which permit the entrance of the specimen and photographic plate without necessitating the evacuation of the entire chamber.

The specimen is mounted in the instrument between 1/100,000 inch thick sheets of collodion. These sheets

(Continued on Page 20)

Frost-Heaving of Soils

By J. O. OSTERBERG
Associate in T.A.M.

For many centuries the effects of winter frost on the ground and on structures have been observed, but not until recently has any explanation or experimental study been undertaken. Frost heaving, instead of being caused by the expansion of the pre-existing soil water in situ, as has been generally assumed in the past, is caused by the growth of ice, which separates from the soil in layers.

An examination of a sample of heaving ground will show that the ice appears in regular strata or lenses of varying thickness, and the total thickness of all these layers corresponds very nearly to the total frost heave. The water content is much larger than for unfrozen soil and is frequently even greater than that of soil in a saturated unfrozen condition. Obviously water must be supplied to the freezing ice layers by upward flow from the ground water.

Various soils freeze differently, depending mainly upon grain size. Sands freeze homogeneously, causing negligible heave or none. The finer soils form ice lenses on freezing which appear in a rhythmic pattern of banding usually parallel to the ground surface. The finer the soil, the thicker and more widely spaced the lenses.

The phenomenon of ice segregation is explained physically on the basis of "adsorbed" water. Soil particles exert a molecular attraction on water molecules, the force being large close to the particles and diminishing rapidly at small distances (much less than a micron) from them. This strongly bound or "solidified" water, being under great pressure, has a low freezing point. Freezing thus starts in the center of the pores, where the water is under least pressure, and as it progresses towards the particle surfaces (where adsorption forces are greater) the resistance to freezing increases and hence the freezing point is lowered. Consequently the finer the soil is, the more difficult it is to freeze the whole mass. Tests on clays have shown that at temperatures as low as —78 C there still remain soft and unfrozen layers.

When ice crystals begin to form in the center of the void space, they press against the thin adsorbed water films surrounding the particles, but cannot "squeeze out" the water. Instead there is a transfer of molecules from the films to the growing crystals. To maintain pressure equilibrium, water flows to the films from the unfrozen soil below. Thus the water is under very large tensile stress. Crystallization proceeds, pushing upward and forming an ice layer separating the soil. The ice layer grows indefinitely if just enough heat is conducted upward from below to maintain the prevailing temperature and to remove the latent heat of freezing. Ice layers may thus grow very thick. But as soon as this condition of equilibrium is disturbed, either by a change in surface temperature or by water not being supplied rapidly enough to maintain the thermal conditions, crystals begin to form lower down, at a point where the freezing point is higher. Then an ice layer forms at this new level, and the supply of water to the layer above ceases.

Because of the many factors affecting frost heave, it is difficult to set definite boundary between soils that have absolutely no frost heave and soils that may heave. However, the effect of grain size is so marked that this factor alone can be used as a practical criterion.

Various investigators seem to be in close agreement on the limiting grain size. Below, on the basis of tests on pure fractions (sorted grain sizes), gives an average particle diameter of 0.1 mm as the maximum size that will permit ice segregation under any conditions. Casagrande gives the critical size as 0.02 mm for actual soils(not fractions). Taber, working with ground quartz and other materials, found that at a size of about 0.07 mm, only the faintest evidence of segregation appeared under the most favorable conditions, and that for sizes smaller than 0.01 mm, ice segregation occurred readily. Of course, in natural

Figure 1. Example of differential frost heave.

soils containing many sizes, grain-size distribution is an important factor. Casagrande found that uniformity is very important, and states that for a well-graded soil only 3 per cent of grains finer than 0.02 mm is required to produce frost heaving, while for very uniform soils at least 10 per cent is required. The limiting grain-size curves in Figure 2 were established by Beskow from numerous tests on natural soils.

With decreasing grain size the thickness of the adsorbed water films increases, causing more ice segregation. But when the voids become so small as to reduce materially permeability, water cannot be supplied at a sufficient rate for ice segregation, and the heave is reduced. There is then a certain optimum grain size for which frost heaving is a maximum. Very fine silts heave most; sands do not heave at all; while stiff colloidal clays have practically no heave.

If the depth to free ground water is greater than the capillarity (i. e. maximum capillary rise) of the soil, there can be no flow to the freezing layers and no heaving will occur. For coarse soils of low capillarity, heaving can be eliminated by lowering the groundwater sufficiently. Even for the finer soils, the ground water need be lowered only a few feet to decrease the heave very materially.

Dissolved substances have a marked influence on the rate of heaving. It has been shown that solutions change the ion concentration, which in turn affects the thickness of the adsorbed water films. Calcium chloride and waste sulfite leach decrease heaving rather rapidly as their concentration increases. Since roads are perhaps the structures most affected by frost damage, the following discussion will be limited to road problems, but it should be borne in mind that the same general methods can be used for any other structure. Frost damage to railroads is very important and

in many cases prevention of damage is more difficult than for roads, since very little differential heaving of the rails can be tolerated.

The damage caused by heaving can occur in two principal ways: (1) by the actual heave produced, and (2) by the secondary effect of the softening of the road bed due to the thawing ice layers. Heaving itself would cause no damage if it were the same in magnitude all over, but differential heaving almost always occurs, owing to varying soil composition, varying ground-water conditions, varying depths to bedrock, varying heights of fills and depths of cuts, and other causes. A common type of damage from differential heave is the lifting of the crown of the road. When the snow had not been completely removed but just thrown aside, covering the ditches and the sides of a road, it acts as an insulator and retards the penetration of frost. Where the road is cleared, the pavement is a good conductor and the frost penetrates much deeper, causing more heave in the center. It is quite common to see the slabs on concrete highways tilted, with corner breaks, and the longitudinal joints opened up. Most of the damage can be prevented by careful snow removal. The snow should be cleared from the road completely, and even from the shoulders if possible. Another procedure in snow removal which helps in preventing frost damage is to remove completely the first snowfall during the late fall cold spell. The frost can then penetrate the upper portion of the road bed rapidly, allowing the thick ice layers to grow lower down. In this location they are much less harmful than near the road surface when the spring thaw comes.

The secondary effect of softening of the road bed during thawing causes the most damage to roads. As water is released from the frozen ice layers, and is prevented temporarily from draining away by the still frozen layers beneath, the bearing capacity of the road bed is reduced and a heavy wheel may exceed this capacity and cave in. Where the ice layers are excessively thick, melting may cause "frost boils"—spots where the water content of the soil is above the liquid limit, and the soil is in a liquid, "soupy" state. Flexible pavements will yield and form holes and bumps in such ground. Rigid pavements may bridge over the boils and soft spots, or may crack from the excessive bending moments. The cures for such conditions are several: stabilization of the road base by proper selection and grading of materials, prevention of boils by replacement with other materials, effective drainage, and placement of an insulating bed.

Let us now consider places where we may expect heave in a road bed. The importance of depth to ground water has already been discussed, and it is obvious that we may expect heave where the depth is least. Thus in general, heaving occurs most in cuts and least in fills. On sloping ground, where there is part cut and part fill, the heave may be very large on the inner side of the road and small on the outer, causing tilting of the road bed that may be even perilous to traffic. Excessive heaving and frost boils may occur in spots where the road is quite level and does not pass through cuts or fills. At such places one usually finds that the bedrock or impermeable layer is higher than elsewhere and the ground-water surface is thus brought closer to the surface. In places of high ground water, where fills are made of heterogeneous material dumped at random, and care is not taken to eliminate dangerous frost-heaving material from the fill, large differential heaving will occur.

Practical methods of preventing damage from frost heaving are numerous and no specific rules can be given because the amount of heave, the damage experienced, and the control required vary so considerably. However, the following general methods may be considered:

1. Lowering the ground-water table.
2. Prevention of upward flow of water by a thin layer placed below the road bed.
3. Decreasing the depth of frost penetration by a heat-insulating material.
4. Excavating the soil completely to the total frost depth and replacing it by a non-frost-heaving soil.
5. Chemical treatment of the soil.

Of these methods, the most general and most important is the first. Drains installed to prevent or decrease heave must be placed at a sufficient depth below the road bed to keep the ground-water level at the desired elevation.

Figure 2. Example of differential heave.

Generally these subsurface drains can only be expected to decrease heave to a nominally permissible magnitude, since they cannot remove capillary water and since the capillarity of frost-heaving soils lies between 4 and 30 ft. Cases in which such drains can prevent heave entirely are those in which the soil is comparatively coarse (capillarity less than the depth of drainage) and those in which the heaving soil lies on top of a coarser material, so that the subdrain will cut down sufficiently into the coarser soil to break the capillarity. Deep drainage can be very effective on side slopes. Here the drain should be laid on the upslope side of the road under the surface drainage ditch, where it can intercept the high ground water and lower it under the road bed to the level of the bottom of the drain. Such a drain generally consists of a deep trench (6 ft. or so) filled with gravel or coarse sand, with a tile drain at the bottom. Where it is necessary to prevent heave entirely and the ground water cannot be lowered sufficiently by drainage to accomplish this, either excavation and replacement by non-frost-heaving soil or insulation must be resorted to. Excavation to the entire frost depth and placing of new materials is an expensive process and may not be economical. In many cases it is cheaper to place a layer of very stiff clay underneath to prevent upward flow. Where this is done, the tight layer must absolutely never come below the ground-water table, for then it would be useless.

Heat insulating materials have been used quite successfully in some places. Peat moss placed near the surface has been found to work well in preventing frost penetration. On slopes of cuts where mud flows caused by excessive water content may induce slides or slumping, thus blocking the road and side ditches, the formation of thick ice layers may be prevented by insulating the slope with a few feet of cinders or sodding with turf. Chemical treatment to decrease heaving has been tried with good results in some instances, but a further study and a satisfactory demonstration of the practicability of this method is still needed.

For problems in frost heaving on existing roads, any of the methods previously described may prove useful. Careful studies should be made of places causing trouble before

(Continued on Page 22)

AFTER THE PEACE—What?

By W. N. FINDLEY
Associate in T.A.M.

We Americans are determined that cost what it may we will win this war but we are equally determined that the price that we shall be called upon to pay shall not be paid in vain. In the words of President Roosevelt, so enthusiastically received on December 10, 1941, "We are going to win the war and we are going to win the peace that follows."

Our first thought and our greatest effort in this emergency must be directed to winning the war, but we must remember that *unless we take the time and make the effort now to prepare a blueprint for peace and start building in accordance with that plan the peace that follows the war will be but a fleeting dream.*

What do we mean when we say that we will win the peace? Do we mean that we shall so plan that at the conclusion of the war we in America shall maintain our national income, our high standard of living, that there will be no unemployment and no depression? Yes, we mean all of that but only as secondary objectives to be planned along with the primary objective—winning the peace. By winning the peace we mean primarily that we shall formulate a peace settlement which will leave no cause for nation to war upon nation and that we shall maintain such relations between the people of the world that war will never again return to the earth. This is the high purpose to which all America is dedicated—a purpose which will require straight thinking and an all-out effort on the part of everyone.

The cause of democracy and of all free men everywhere needs the helpful guidance of the engineer and scientist, with his training in analytical work—and engineers and scientists are giving full measure of help in the construction of factories, homes, barracks, tanks, planes, guns, and all sorts of other material for the armed forces and civilian workers in war industries. But democracy for the armed forces and civilian workers in war industries. But democracy needs the cooperation and guidance of the technically trained mind not only for production of armament for defense but also to make the plans and supervise the construction of a just and enduring peace.

World War II more than any previous war is a war in which engineers, and scientists, play an all-important role. We engineers and scientiststs must build the weapons of offense and defense, and "detail" the strategy which will spell victory or defeat.

The treasury expenditure for war activities during the calendar year 1942 was 50 billion dollars and it is estimated that in 1943, 53 billion dollars will be expended for the construction of war material. The engineer is responsible entirely for rapidly and efficiently producing this material. During 1942 we produced 49,000 planes, 32,000 tanks, 17,000 anti-aircraft guns and 8,200,000 tons of ships. For 1943 President Roosevelt has set as our goal 125,000 planes, 75,000 tanks, 35,000 anti-aircraft guns and 10,000,000 tons of shipping. The colossal task of designing and building this equipment in the specified time is set squarely upon the broad shoulders of the nation's engineers.

But, shall we, who have such a large responsibility in providing the materials of war, be content with merely winning the war, and, as in the past, leave to others the problem of winning the peace—others who in the last post war arrangements demonstrated their utter inability to cope with the problem? No, it is important that everyone—engineers, scientistst, and people in all walks of life—should work together on this problem and make sure that the United States does not once more, by refusing to cooperate, prevent the formation or operation of an effective world government. We must start now to build the foundations for the kind of world in which we would like to live—the kind of world in which free men may remain free.

What must we do in order to win the peace? Several answers have been proposed to this question—repression of militant nations, the balance of power, the League of Nations, isolation. Many of them have been tried at various times in the past and have failed. There is, however, one answer which has not been tried on a world scale. Yet on a smaller scale it has had 156 years of unparalleled success and growth. This answer is the same answer that Americans gave in 1787—a method of uniting states into a single union under a government whose sole power is to regulate and control interstate and foreign relations. The growth and success of this union method has been tremendous, yet its growth has been far outstripped by the increase in the rapidity of communication and the extension of commercial relations to all parts of the globe.

The engineer is responsible for conquering time and space through the invention and development of such things as the airplane, automobiles, radio, telephone, etc. But in developing this mechanized world without at the same time providing the world economic and political machinery to go with it, the engineer has developed a machine without a pilot, a Frankenstein without a brain. And this fact that the world is without unified economic and political direction is largely the cause of our present difficulty. To form the basis for a unified economic and political system, some form of world government must replace the principle of national sovereignty. The type of world government which seems to have the greatest probability of success is the American invention of a federation or union.

When should we start a program to win the peace? We should start now to think and discuss the post-war problems and to prepare detailed plans for the post-war world so that when the time comes for action the United States will not be found unprepared, and will be ready to take her part in a program for peace and order.

But in this planning we must not lose sight of the fact that the topic of post-war arrangements is highly controversial and that no formula has yet been devised which seems able to encompass all the variables of this highly complex problem. It is quite evident that even under the most favorable circumstances many years must elapse before great sections of the world's population will be capable of taking part in self-government. So that the final answer to the problem may be some form of improved and empowered "league of nations" to maintain order until such a time as a permanent world union can be established.

However, it may be argued that it is better to make the most of an opportunity to take the first steps toward our goal than to risk gaining nothing by waiting for an opportune moment to accomplish our ultimate objective in a single stride. With this in mind the following proposal may be worthy of study as an immediate step toward eventual world government.

(Continued on Page 16)

Battle without headlines!

The men and women of Bell Telephone Laboratories are directing their energy these days to developing new and better communication equipment so vital in today's swift-moving global war.

Peacetime developments, pioneered by Bell Laboratories, are seeing action on every front. Many of their war-time achievements should prove stepping stones to progress in the coming days of victory and peace.

Service to the Nation—in war or peace, that's the one ideal of Bell System people.

WAR CALLS COME FIRST!

BELL SYSTEM — AMERICAN TELEPHONE & TELEGRAPH CO. AND ASSOCIATED COMPANIES

NAMES *in the* NEWS

By WILLIAM SCHMITZ, Ch.E. '45
and
LEE SULLIVAN, M.E. '46

JIM ROACH

That genial engineer who always wears a smile and always greets you with a cheery note is Jim Roach, a senior mechanical engineer. This season Bloomington's gift to Ed Manley has already earned his third "I" for swimming. Through his brilliant career as a freshman splasher, Jim was selected as the swimming team's representative to the

JIM

Beta Kappa dinner, given for the outstanding freshmen of each sport. At this dinner he was given the Beta Kappa award for the most outstanding freshman athlete with the highest scholastic average. Through his swimming, Jim was initiated into Dolphins, honorary swimming society.

In his freshman year also Jim was initiated into Phi Eta Sigma and since then has kept a neat 4.1 average. Besides swimming, Jim's activities included a position in Junior Cabinet of the Men's League.

During the summers Jim has worked at different jobs, but the one he enjoyed the most was being lifeguard at Bloomington Country Club swimming pool last summer. Jim figured his association with all the pretty girls was good enough, and considered his salary as a bonus.

Jim likes almost any sport, and enjoys participating in intra-mural sports for his fraternity, Sigma Chi. B. R. (before rationing) Jim used to design, make, and fly gas model airplanes, but now that he can't get the gas and swimming and studying take too much of his time, Jim has had to give that up. There's one thing that Jim still like to do, though, and that's love. As Jim says, "There's nothing like a solid session, now and then, mostly now."

After graduation, he hopes, Jim will don Navy blue and learn to fly for his Uncle Sam. Jim's enlisted in the Navy V-5 and hopes that he'll be allowed to finish this semester so he can get his degree.

RAY ACKERMAN

One of those extra-busy little men who roams the north campus is Ray Ackerman, senior civil engineer. Besides carrying twenty hours, Ray has taken on the positions of President of Chi Epsilon and co-vice president of the A. S. C. E. He is also a member of Sigma Tau.

Ray, a native of Morton, Illinois, has done very well for himself here at the U. of I., making a 4.2 average for three and a half years. Although his activities and studies take up most of his time, Ray takes time out now and then to enjoy a few lines of bowling, at which he is pretty good, we understand. His other main outside interest is a good rough game of ice hockey, in season.

When Spring and warm weather come around, however, Ray sneaks away from the books off into the fields to do a little hunting. The day after pheasant season opens, Ray is usually seen sporting a pheasant feather in his cap. Craving the out-of-doors, Ray also likes to fish, claiming a ten pound muskie as one of his better catches.

Claiming a 2-A draft classification, Ray will receive his

RAY

degree this June and depart for the sunny state of California, where he will become a man behind the man behind the gun (airplane). He has a position with Douglas Aircraft Corporation awaiting him there.

WILLIAM G. MURPHY

Introducing Lieutenant William G. Murphy. Lt. Murphy, better know as Bill, was originally of Pittsburgh, but his present home is Decatur. Bill, a senior civil engineer, is a member of the A.S.C.E., Alpha Tau Sigma, and Scabbard and Blade. Before coming to Illinois, Bill had a fine collection of stamps, but has had to give that up for the more important work of school.

Bill is interested in all kinds of sports and is all for the stiff physical education courses. He believes that everyone should be in good physical condition so he can help to do the job at hand today. Bill is most interested in the structural courses he is taking. He believes that there is a great deal to be done in that field.

Bill's main interest is, however, the army. He spent three years at Kemper Military Academy, where he received his Associate in Arts degree. From there he went to military summer camp at Camp Riley, Kansas. This was the first step toward getting his commission. Then Bill came to the U. of I. to continue his military and civil

engineering work. He became a cadet in the advanced course and was a cadet major in the Infantry last semester. As he has completed his training for a commission, Bill is now Lieutenant Murphy.

If he can keep his average up until April 2nd, Bill will receive his B.S. degree and leave for Camp Croft, South Carolina, where he will get more training. Then, on May 1st, Bill will be transfered to Fort Benning, Georgia, where he will enter the Heavy Weapons and Rifle Company Commanders School. After that, Bill hopes to transfer to the air-borne infantry, and from there into active duty. Here's hoping everything goes well, and, good luck, Bill.

BILL

OLIVER SCHMIDT

Here's one fellow we bad a hard time getting hold of. Yes, this is one engineer who doesn't bury himself in his books all the time. Oliver, a native of Cissna Park, is a mechanical engineer who sings second tenor in the Men's Glee Club, is a member of Phi Eta Sigma, Tau Beta Pi, was treasurer of Pi Tau Sigma last semester, and is a first lieutenant in the advanced course Engineer unit. He is also president of his independent house, Club Topper.

Oliver is interested in woodcraft, having done quite a bit of whittling before the engineering courses made him turn to the books. He also likes to listen to any piece of classical music. When he can find time, Oliver likes to play basketball and golf, and enjoys a good swim now and then.

Internal combustion is a subject which interests Oliver the most. He would like to seek further knowledge in that field, as well as in machine design. He says that these are the two most interesting courses he is taking. A revision in the mechanical engineering curriculum would suit Oliver just fine, for he believes that hydraulics should be a required course for a mechanical engineer.

Oliver doesn't date on campus, not because he doesn't like the girls here, but because he's true to the girl back home. With all the uncertainties of the world today, however, he has made no definite plans for the future.

Being in the advanced course, Oliver expects to leave in June for Fort Belvoir, Virginia, where the Officer's Candidate School for engineers is located.

STEVEN YURENKA

Steven Yurenka, or Steve to his friends, comes from Cicero, Illinois. He started his college education at Morton Junior College, which is located in his home town. When he had completed two years in engineering at Morton, Steve

OLLIE

came to Champaign-Urbana to finish school as a mechanical engineer. Now in his last semester, Steve boasts a 4.49 all-University average, one which anyone would be proud of. Because of his good work, Steve has been initiated into Tau Beta Pi and Pi Tau Sigma, of which he is now vice president. He is also chairman of the American Soicety of Mechanical Engineers.

While in high school and Morton Junior College, Steve spent much of his time reading for pleasure. Since he came to the U. of I., however, Steve has had to change the books he reads, for most of his time is spent studying. When he first came here, Steve became interested in weight-lifting and ever since has tried to put an hour or so each day aside for this purpose. Steve passes his afternoons in Talbot Laboratory, where he has a job working with Mr. Findley on fatigue tests of cellulose acetate and aluminum. There is more about this in another article in this issue.

Claiming a 2-A draft classification, Steve will finish school and then go to work for Allis-Chalmers Manufacturing Company. He has picked Allis-Chalmers because they give a two years training course with the actual work, which appeals to him because it serves as a good transition from school to work. Another reason for picking that company is that he is mainly interested in machine design and figures that he can learn much from the large machines in the Allis-Chalmers plants.

STEVE

Our Societies . . .

By BYRON ROBINSON, M.E. '44

A.S.M.E.

The new officers of A.S.M.E. for the second semester 1942-43 are as follows:

Steve Yurenka ..... *Chairman*
Alan Park ..... *Vice-Chairman*
Bernard Lattyak ..... *Secretary*
George Mays ..... *Treasurer*

On the evening of March 17, the A.S.M.E. presented four very interesting and entertaining motion pictures at 107 M.E. Lab. The titles of the films were as follows: "Romance of Radium," "Television," "Bowling Aces," and "The Japanese Relocation."

CHI EPSILON

Chi Epsilon held meetings on February 23, and March 4, at which time prospective members were considered and selected. Faculty and student members participated in an open discussion at the March 14 meeting which was a bid smoker held at Triangle fraternity. An Honor Roll of former Chi Epsilon actives who are now in the armed forces is being prepared for "Transit", the national publication of Chi Epsilon.

PI TAU SIGMA

Pi Tau Sigma held a rushing smoker at Triangle fraternity, Wed. March 10. Prof. O. A. Leutwiler presented the history of Pi Tau Sigma especially for the benefit of the rushees. Elmore Mays, last semester's president, was presented with a gold gavel in appreciation of his services to the organization. Each rushee was presented with a non-technical question, the answers to which were very entertaining. The plentiful supply of refreshments was quickly depleted.

S.B.A.C.S.

The officers of S.B.A.C.S. for the second semester 1942-43 are as follows:

Payson Shonkwiler ..... *President*
Eugene Lynch ..... *Vice-President*
Gordon Q. Johnson ..... *Secretary*
Bill Prentice ..... *Treasurer*

The comparison of chinaware of different countries was the subject on which J. J. Svec, Managing Editor of "Ceramic Industry," spoke to the S.B.A.C.S. on March 4.

A.S.A.E.

On Tuesday, March 9, Mr. K. J. Trigger of the M.E. department spoke to the A.S.A.E. about steel for farm implements. In his talk, Mr. Trigger stressed the fact that very large amounts of steel are necessary in the farm machinery industry, and also in other major industries, and because of this large demand, it is possible that post-war materials will be competing with steel, although steel will probably hold its supremacy.

TAU BETA PI

Tau Beta Pi held its annual spring rushing smoker at the Lambda Chi Alpha fraternity on March 11. A discussion of current events was held for the purpose of getting acquainted. Refreshments were served to conclude the meeting. The examination for the candidates was held on March 23 in Mechanical Engineering Laboratory. The initiation is scheduled for an early date.

A.I.E.E.

On Thursday, March 4, 1943, A.I.E.E. elected the following men to lead their organization for the second semester 1942-43:

Pete Fenoglio ..... *President*
Raymond Shick ..... *Vice-President*
Earl Boesenberg ..... *Secretary*
Richard Johnson ..... *Treasurer*

TAU NU TAU

On February 23, at the Sigma Pi fraternity, Major Albert, F. A., spoke to T.N.T. about the coordination of the Field Atillery with the Infantry in battle. At a rushing smoker, held March 2 at Alpha Delta Phi fraternity, Colonel Wilkes, C.E., gave the history of T.N.T. Instructions to twelve pledges were given at the formal pledging meeting held March 9. On March 16, a meeting for pledges only was held.

The Sophomore Award presented annually by T.N.T. was received by Lucien Wilkes, who received a silver medal for first place, and Lyle Lanning, who received a bronze medal for second place. This award is presented to outstanding sophomores in the Engineers Basic Course R.O.T.C.

A.S.C.E.

Prof. W. C. Huntington gave an interesting lecture, illustrated by slides, at the first A.S.C.E. meeting of the semester on Wednesday, March 3. His subject was "Ailments of Dams." It is not generally known, but most large dams, although structurally sound, are disintegrating and cracking so severely that maintenance costs are exorbitant.

A small group attended the first social affair, which was a radio dance held at Triangle fraternity Saturday, March 6. The social chairman, Dick Webster, did a good job of arranging, and those present enjoyed the evening. Prof. and Mrs. W. A. Oliver were chaperons.

Officers of A.S.C.E. for this semester are as follows:

Bud Christianson ..... *President*
Homer Wong, Ray Ackerman ..... *Vice-Presidents*
Louis Brown ..... *Treasurer*
Eugene Estes ..... *Secretary*

What's the hottest spot in a Dog Fight ?

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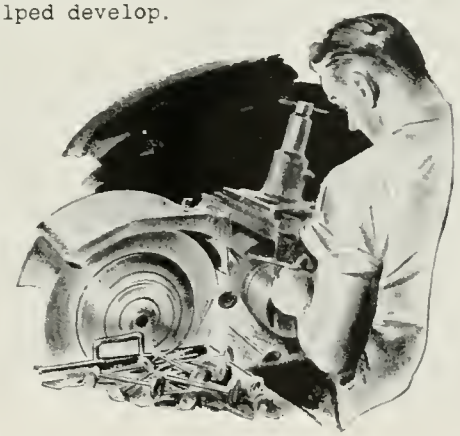

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AFTER THE PEACE—WHAT?

(Continued from Page 10)

It is suggested that a union of free peoples be formed immediately in order to aid in winning the war. Effective unity of command in military activity and in defense production can only be obtained by means of a union not by an alliance. The position of the anti-axis nations has been greatly improved by the unification of command between the American and British forces. But this unification of command is based on the alliance method—a method whose glaring defect was all too forcefully brought home to the British and French when France made a separate peace with Germany—contrary to the provisions of their alliance. And the British could do nothing about it any more than we could do anything about if the British were to decide now to make a separate peace with the Japs and concentrate their efforts on the European phase of the war.

A union of free peoples should be formed now rather than after the war because now we have a tremendous binding unity of purpose to win the war and the peace, whereas after we have won the war we may lose sight of our ultimate goal—to win the peace. Those of us who have suffered, whose homes have been destroyed and sons killed may become blinded by desire for revenge, and those of us who have been fortunate enough to escape all but the labor and hardship of a war-time economy will be distracted by the desire to return home, to isolate ourselves and enjoy a much needed rest forgetting that the job is but half done.

How might we begin a world union of nations? A beginning has already been made. The inter-American conference at Rio de Janeiro resulted in an alliance of 26 anti-axis nations—the number has now increased to 31. Perhaps even more significant, the Rio Conference has resulted in the formation of an inter-American commission of military and naval officers; the recommendation that all commercial and financial intercourse with the axis cease; and the recommendation that all trade barriers barring a maximum productive effort be removed.

But this is not enough. We must remember, that even though this alliance is called the "United Nations," it is not a union since it is based on the government-to-government, unanimous consent type of negotiation. In forming this alliance in such a short time we have accomplished much but we must accomplish a great deal more. In order to win the war and the peace, the solidarity of the "United Nations" must be extended by forming a union of at least the more influential of the 31 nations.

It is realized that there are several forms which a union of nations might take successfully. The following form is, however, suggested for consideration as that which at the present time seems to have the most to offer.

The relationship between the nations in the proposed union might be similar in many respects to the relation between states in the United States. That is, the nations of the union would discard the principle of national sovereignty and vest in the government of the union the power to govern the foreign relations of the union, including the power to make war and peace; to maintain a common defense force, a common currency, and a common communications system; to regulate commerce and maintain free trade between nations of the union; and to operate directly on the individual citizen.

It seems essential, in order for a union to function more effectively than an alliance of nations (the systems we now have), that the governing body should be made up of representatives of the *people* of each nation with provision for safeguarding the interests of the smaller nations, similar to the provisions in the Congress of the United States for safeguarding the interests of small states. The citizens of all nations of the union would be citizens of the union while still retaining citizenship in their home nation, just as citizens of the United States have also citizenship in some home state. The union, on the other hand, would guarantee to all its citizens equality before the law and the fundamental freedoms and rights of the individual, such as—freedom of religion, speech, press, and peaceful association.

Such a union of nations should extend to all nations the privilege of joining the union and sharing in its benefits and responsibilities on an equal basis with the founder nations at any time that they demonstrate their ability in self-government based on the principles of freedom and the rights of man.

The forming of such a union will of course require many readjustments because of the removal of protective tariffs and the like. It may even work a hardship temporarily on some groups of people, but these hardships and readjustments will be infinitesimal compared to those which we are undergoing today.

If as suggested, we form a union of democracies now for the dual purpose of winning both the war and the peace, it is to be hoped and expected that the peace terms which the union asks of its opponents will exemplify the ideals for which we are fighting—freedom of the individual and justice and fair-dealing in international relations. In accordance with these ideals the union should offer to make peace with the world on the basis of: no reparations, annexations or reprisal measures; no punishment by the union of axis nationals, and arbitration of any disputes that cannot be settled by negotiation. At the same time the union should offer to take into its membership any nation which desires to enjoy the advantages of a federation

(Continued on Page 20)

CUTTING TOOLS THAT NEVER DULL

FASTER than ever before—and with fewer delays—man shapes steel with the Airco oxyacetylene flame. There's no time out for sharpening or regrinding when this modern cutting tool is on the job. Here the Radiagraph—an Airco achievement—is depicted utilizing the oxyacetylene flame to perform a highly specialized cutting operation. So versatile is the standard machine that it does the job speedily, accurately without the aid of special attachments.

New, faster, better ways of making machines, engines, ships, tanks and guns result directly from using this "never dull" production tool. So varied is its application that, in addition to cutting steel swiftly and accurately, the oxyacetylene flame hardens steel to an easily controllable depth, cleans metal surfaces for longer lasting paint jobs, welds metal into a strong, lasting structure. To better acquaint you with the many things that this modern production tool does better we have published "Airco in the News", a pictorial review in book form. Write for a copy.

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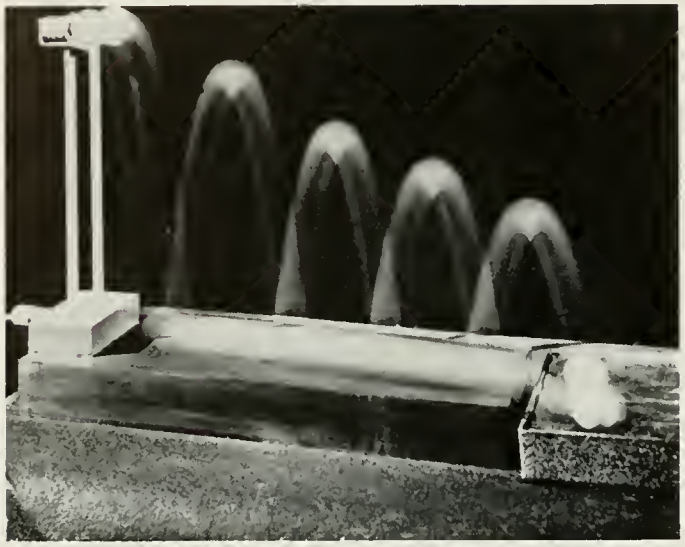


(Cut Courtesy Westinghouse)

BOUNCELESS BALL

Westinghouse engineers have found that a steel ball half-filled with metallic powder will not bounce, as this time-exposure photograph illustrates. This discovery has been used to prevent poor connections by eliminating bouncing and chattering in electrical relays. The relay contacts are made hollow and partly filled with powder, or special hollow powder containers are attached to the contacts. Two balls of the same weight—one empty and one containing powder—were dropped simultaneously from the top of the posts, left. The empty ball left a looping trail of light as it bounced four times. The ball containing the powder rolled without bouncing, as shown by the straight streak of light. Rough surfaces of the metal powder particles created frictional heat, as they slid over each other, dissipating the energy the ball would have used in bouncing.

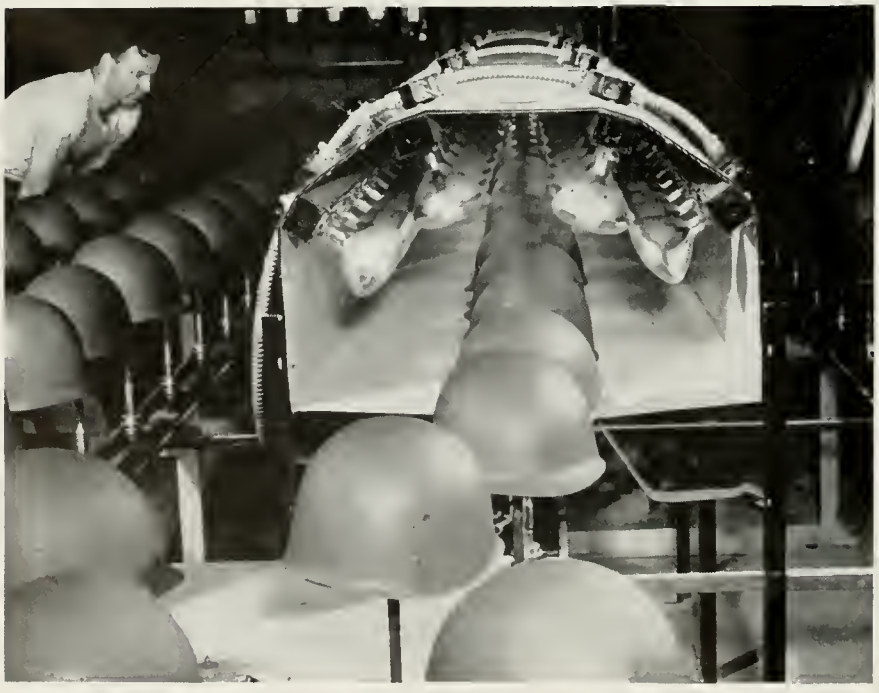
(Cut Courtesy General Electric)

PORTABLE FLOODLIGHT FOR COMBUSTIBLE AREAS

A portable battery-operated floodlight has been announced by the Illuminating Laboratory of the General Electric Company especially for combustible areas which cannot have installed lighting. This unit is intended for use in such places as powder igloo interiors, powder magazines, freight car and warehouse interiors containing combustibles, and during blackouts and other emergencies.

The floodlight consists of a small steel box (19 in. by 9 7/8 in. by 20 3/4 in.) with a special dust- and vapor-proof lamp housing mounted on a bracket to allow pointing in any desired direction. A high-efficiency glass reflector, combined with pre-focus positioning of the unit's 50-candlepower concentrated-filament type bulb and a diffusive lens, gives a powerful medium-angle floodlighting distribution.

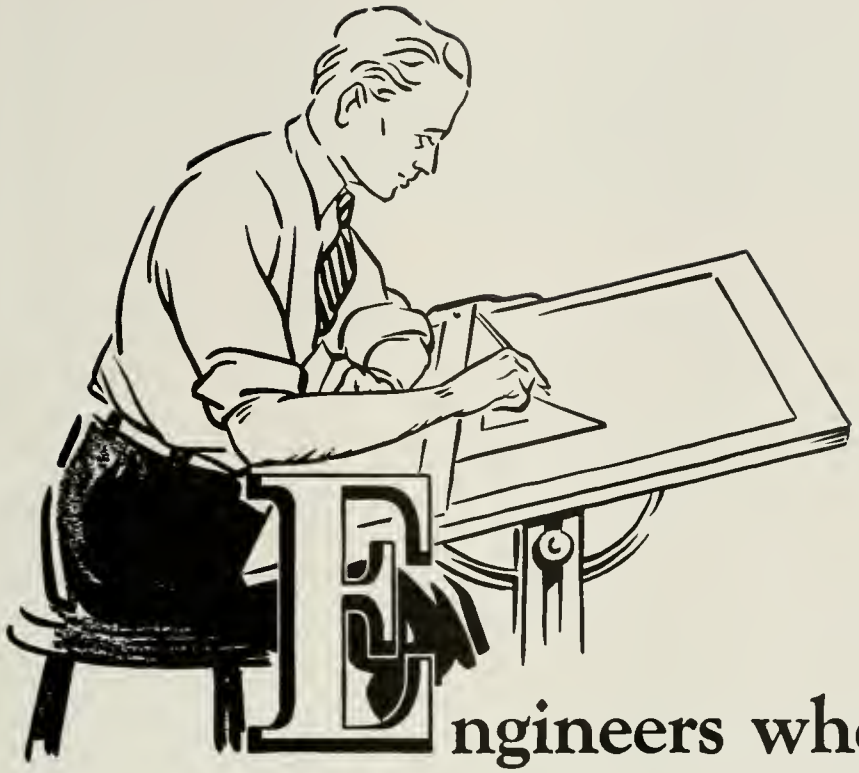
A 5-cell storage battery with nonspill valves is housed in the box. Quick exchange of discharged for charged batteries is made possible through a polarized connector permanently wired to the battery terminals. Normal burning time for the unit is approximately 10 hours.



(Cut Courtesy Westinghouse)

PLASTIC HATS GO TO WAR

These freshly-painted plastic helmet liners pass under the drying rays of infrared lamps on their way from a Westinghouse production line to the battlefront. Made of tough Micarta plastic, these "hats" are the inside half of Uncle Sam's new two-part, double purpose helmet. Strong as steel of the same weight, the 12 ounce headpieces give soldiers adequate protection during non-combat duty. In battle, they provide comfort and heat insulation when worn inside two-pound steel helmets.



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OUR ELECTRON MICROSCOPE

(Continued from Page 7)

are formed by placing a drop of collodian on a still water surface. This in turn is supported on a very fine wire mesh and observations are made through one hole of the mesh. It can be seen that the nature of this instrument imposes certain conditions on the type of specimen. For example, the specimen must be transparent to electrons. In the study of metal surface finish, an extremely thin coating of plastic is placed on the surface and then stripped off. This film takes on the same pattern as the surface and can be observed in the microscope.

The University of Illinois was the first school to own an electron microscope. The instrument, which is located in Noyes Laboratory, was built by RCA and cost approximately 10,000 dollars. The work done here is under the direction of Dr. G. L. Clark. Some of the more recent studies have been concerned with carbon black (for use in synthetic rubber), lime particles, soils and clays, soil bacteria, Illinois coals, sperms and the finish of metal surfaces.

ROTOR BARS REMOVED TO AVOID LONG SHUTDOWN

Recently a 350 hp motor, driving a centrifugal refrigeration machine, broke down and threatened to tie up half the capacity of an alcohol refinery. Fractures of the rotor-bar-brazing had developed and re-brazing would probably have caused breaks at other points. Westinghouse engineers recommend winding with copper and this was promptly done. Sharp corners, where the bars were notched for the end ring, were removed and the motor was back in service in a week.

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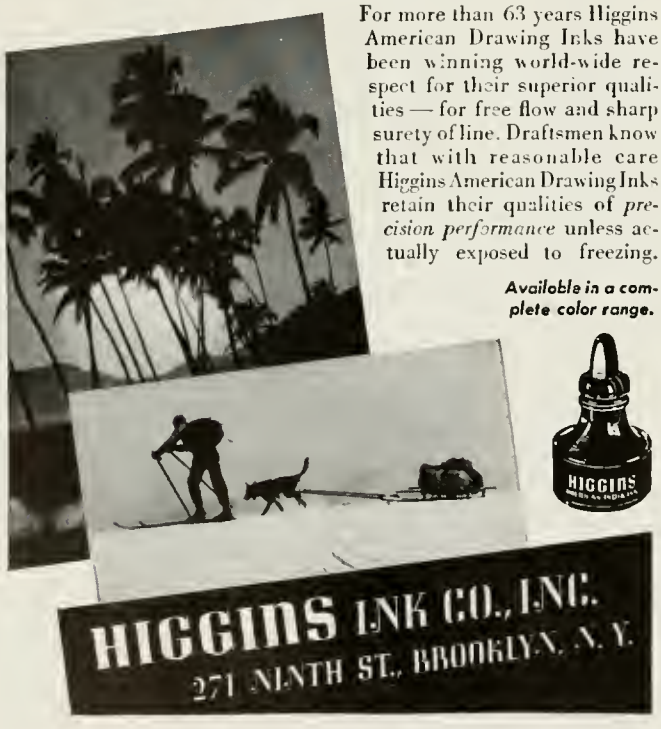

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AFTER THE PEACE WHAT?

(Continued from Page 16)

of nations and is willing to assume the responsibilties of membership.

The formation of a union, as proposed, would encourage axis dominated democracies to rejoin the fight for freedom, overthrow their totalitarian tyrants and unite with the union; and the adoption of a peace proposal, such as outlined above, by a union having the prestige, integrity and power of the one proposed would tend to remove fear of defeat from the minds of the peoples of totalitarian countries. Hence such a program should materially aid in winning the war and in setting up the conditions for a just and enduring peace.

Finally regardless of what decisions may be made about an immediate union of nations we must all as individuals strive to prepare America to take an active part in post-war economic and political arrangements.

BIRD GUN TESTS PLANE WINDSHIELDS

With plane speeds increasing, the risk of a large bird crashing through the windshield and endangering the life of the pilot and all others aboard demands attention. Under the guidance of the Civil Aeronautics Administration, a cooperative scientific study of just what happens to the windshield of a plane when struck at high speed by a heavy bird, is being made by airplane operators, builders and suppliers. The purpose is to learn how to construct windshields that have greater strength against such impact. The study is being made, strangely enough, in a Westinghouse laboratory used primarily for testing circuit breakers.

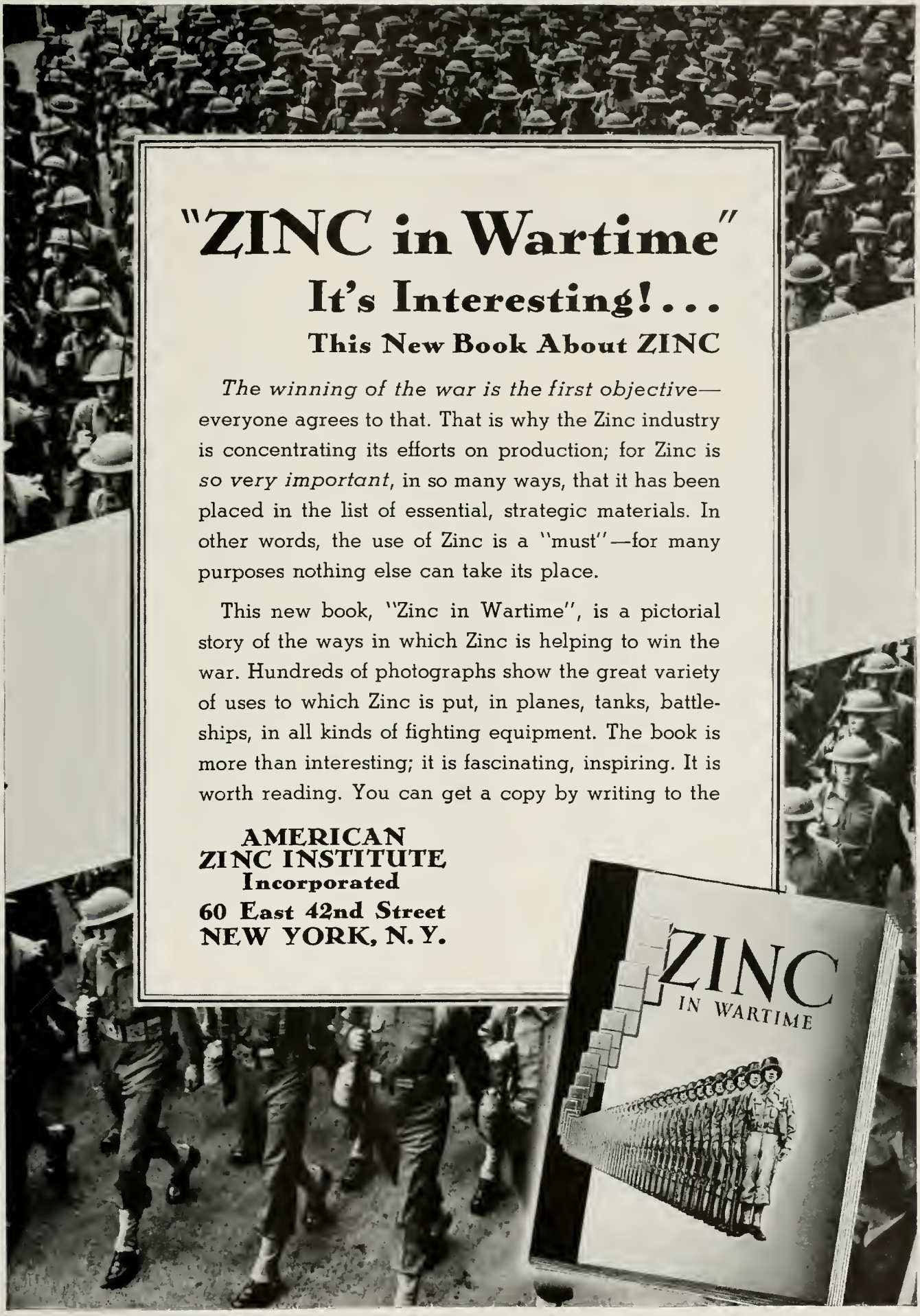
The test equipment consists of a high-velocity compressed-air gun, designed and fabricated by engineers of the Westinghouse Engineering Laboratory. The gun which has two interchangeable barrels, one five inches, and the other ten inches in diameter — both 20 feet long, is connected to a reservoir of air under high pressure. Loaded with an electrocuted chicken or turkey the gun is fired at the test windshield. Velocities far above plane speeds now contemplated, can be achieved.

Approximately a hundred tests have been made, using different speeds, angles of impact, sizes of birds, and types of windshields. Already Civil Aeronautics Association engineers have learned how to increase the impact resistance tremendously. A standard transport plane windshield broke when struck by a four-pound bird at a speed of 75 mph. The latest windshields tested withstood the impact of a four-pound bird at 300 mph., and of a 15-pound bird at over 200 mph.

The Westinghouse laboratory is remarkably well-suited to such unusual tests. Large outdoor test cells, where circuit breakers are deliberately tested to destruction, provide an ideal shooting range. Oscillographs, cameras, and recording devices are at hand, and compressed air is available in quantity. The most important part of the gun is the trigger. Fortunately a high-speed air valve, recently developed for use with compressed-air circuit breakers, served the purpose without modification. This is another remarkable illustration of how the tools of peace are helping to hasten the day of victory.

SQUEEZING OUT KWH

Saving enough on losses for the utility company to pay the interest on the investment, Westinghouse experts recently rewound the stator of a 23,750 kva turbine-generator without use of additional critical material. The reduction of 335 kw in no-load losses and 400 kw in full-load losses makes a few more kwh available for war production.



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This new book, "Zinc in Wartime", is a pictorial story of the ways in which Zinc is helping to win the war. Hundreds of photographs show the great variety of uses to which Zinc is put, in planes, tanks, battleships, in all kinds of fighting equipment. The book is more than interesting; it is fascinating, inspiring. It is worth reading. You can get a copy by writing to the

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FROST-HEAVING OF SOILS

(Continued from Page 9)

any remedy is tried. In many cases a trial drain, or insulating bed, or bed of coarse material demonstrates the effectiveness of each method. For new roads, a complete soil survey should be made. With proper control and placement of fills and proper drainage installation, most frost heaving problems can be solved.

PRECIPITRONS GO TO WAR

Dust oil and smoke can seriously effect the nation's war effort, according to Westinghouse engineers. The Precipitron is useful for removing from air breathed by desert engines, thus lengthening their life. So as not to betray a ship's presence below horizon, the smoke from its stack can be eliminated by a similar electrostatic separator.

DESIGN 24-VOLT AND SEARCHLIGHT

Military authorities recently required a powerful searchlight for operation on 24 volts d-c. According to Westinghouse experts, engineers accomplished the impossible, since arcs normally become unstable at less than 55 volts. A new type of carbon electrode plus a new control scheme produced a light stable even at 18 volts with a light beam of 50 million cp. Not only that, the light is more efficient than previous models.

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STATIC ELECTRICITY INTERFERES WITH WAR EFFORT

Static electricity experiments have demonstrated that rubber tires impregnated with conductive materials drain static charges from trucks used in explosives plants, reducing the danger from sparks that might cause an explosion according to Dr. Victor Wouk, 23-year-old Westinghouse research engineer, at the A.I.E.E. winter convention.

Big bombers can build up static charges powerful enough to give discomforting jolts to ground crew men who touch the plane soon after it lands. This useless electricity may be the cause of a gasoline fire. On an extremely dry day, your automobile may build up an electrical pressure of 30,000 volts. These voltages rarely cause any damage in an auto because the amount of electricity your car can hold is extremely limited.

To measure this tiny current Dr. Wouk fastened a wire to the body of a car and connected the wire to a microammeter, an extremely sensitive electrical instrument. Another wire attached to the microammeter was put through the rear window of the moving auto and connected to a steel chain dragging in a grounded steel channel imbedded in an asphalt road. With this apparatus, he was able to make all the electricity in the car body flow back to the ground through the current measuring device.

When a car is driven along a highway, the current stops flowing when the auto becomes fully charged. When that point is reached, all the electricity from the tires goes directly back into the roadway without passing through the body. The charge in a car drains away in a few seconds after the auto stops; it rarely lasts longer than 10 or 15 seconds.

G. E. DEVELOPS MEMORY MACHINE

A memory device, which will retain the image of an electric flash for 1/25 of a second, long enough to open automatically the lens of a camera and make a picture of it, has been developed in General Electric's laboratory.

This electronic robot consists of a cathode ray tube on which a small beam of electrons continuously paint on the thin coating of a flourescent mineral a picture of what is happening. When there is a flash, this device picks up the picture, retains the image long enough for thyratron tube automatically to trip the camera for a 1/50 second exposure.

"Just as the human eye retains the image of what it sees for a fraction of a second, until the nerve system relays it to the brain, so this memory oscillograph holds the image long enough to be photographed," Dr. A. W. Hull, assistant director of General Electric's research laboratory who developed the device, explained.

The device will be used in the study of unpredictable flashes or surges on electrical equipment.

"TAIL-LIGHTS" FOR PARACHUTES

They're now putting bicycle tail-lights on parachutes. This unique example of a peace-time lamp at war is told by engineers at the Westinghouse Lamp Division, Bloomfield, N.J. The tail-light formerly made for bicycles has proved to be adaptable for use on parachutes. A lamp and small dry cell fastened to each cargo parachute makes it easier for paratroops to locate supplies dropped to them at night. The same lamp and battery combination fastened to a life preserver aids a struggling swimmer to see it in the dark. The bicycle tail-light is but one of more than 200 peacetime lamps that have been pressed into military service.

This "Carrot" means healthy metals

YOU CAN SEE why metalworkers call this lump of calcium metal a "carrot." This is the way it looks when it comes from an electrolytic cell in which it is made.

Calcium is a soft, silvery-looking metal. Although it is abundantly present in such common materials as chalk and limestone, its recovery as a pure metal is extremely difficult. Yet it is vitally essential to this country.

In the making of stainless or high-alloy steels, calcium drives out impurities, giving cleaner, better steel for casting or rolling. In magnesium casting, small amounts of calcium improve the finish of the surface and minimize scaling. Calcium is an essential in the making of many metals.

This hitherto rare metal has been made in this country only during the past few years. Before Europe exploded, the United States was dependent upon France as a source of supply.

But back as far as 1935, thinking that this country should have a domestic source, ELECTRO METALLURGICAL COMPANY, a unit of UCC, started a major research program. After four years of work . . . as French supplies dwindled . . . a plant was put into operation for the manufacture of the gray metal. Today, ELECTRO METALLURGICAL COMPANY produces many times as much calcium metal as this country ever imported . . . and production is increasing.

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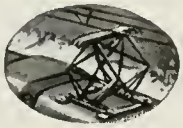
IN THE AIR SOONER! Vital aircraft parts flow from production lines quicker because the use of calcium metal results in better metal.

BETTER HEALTH! Pure calcium metal is used as a drying and purifying agent in the manufacture of certain new disease-fighting drugs.

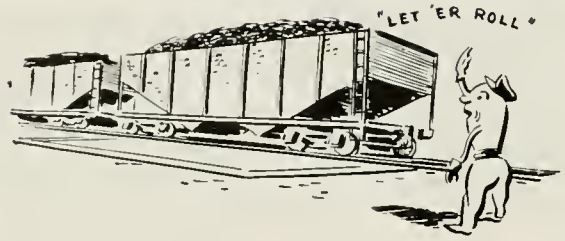
CHEMICAL HELPER! Calcium is necessary in making a number of rare metals—many of which heretofore were unavailable commercially—and all of which are vital.



METAL-SAVER! In the melting of copper scrap for use in certain types of electrical equipment, calcium is used as a purifier and a restorer of electrical conductivity.

BUY UNITED STATES WAR BONDS AND STAMPS

G-E Campus News



LET HER ROLL!

AT A PLANT of the Hanna Coal Company in Ohio, loaded coal cars are emptied by being rolled onto a rotary dump, fastened to the rails by a mechanical device, and then rolled upside down over a chute.

Now the dump is not supposed to revolve again until the empty car has been righted and sent on its way. But once in a while, when a car took a particularly long time to move off, the dump would revolve the next full car and derail the empty one.

The difficulty was remedied when a G-E photo-electric relay and light source were installed on opposite sides of the track at the "empty" end of the dump. Now the dump can't revolve so long as the light beam between the light source and the phototube in the relay is blacked out by the body of the empty car.

NOTHING TO IT

HERE'S how the G-E supercharger works—à la Hollywood.

In Warner Brothers' "Desperate Journey," a Nazi officer asks a captive American flyer, "How do you manage to supercharge the engines at the extreme cold of these high altitudes?"

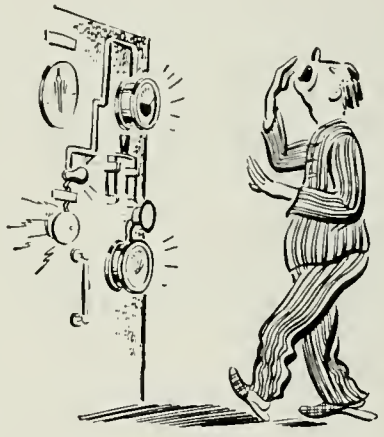
Johnny, the prisoner (played by Ronald Reagan) is crafty. He stalls a bit and then, assured that no one can overhear, he whispers, "It's done with a thermo-trockle."

"A what?" The awed Nazi leans closer.

"A thermotrockle amfilated through a daligoniter," explains Johnny, beginning to sketch with his left hand.

"You see, the dornadyne has a frenicoupling and the amacmeter prenulates the kinutaspel hepulace—here—and the—."

All of which thickens the plot, confuses the Nazi, and gives Johnny an opportunity to slug his guard and escape—without revealing a single military secret.



TESTING

BACK when Herbert Hoover was in the White House, four specimen rods of an alloy steel used in steam turbines were imprisoned in a thermostatically controlled electric furnace at one of the G-E laboratories.

The purpose was to study the effect on the metal of prolonged high temperature and stress, in order to improve the design of the turbines.

Usually these "creep" tests are run for only 1000 to 3000 hours, but the engineers never took these four specimens out of the furnace until the other day—thus obtaining what they believe to be the first data based on a 100,000-hour test.

Throughout the 100,000 hours an ingenious alarm system guarded the specimens. In the event of trouble, a red light would flash and a bell would ring, summoning a watchman who could get one of the engineers out of bed to remedy the situation.

GENERAL ELECTRIC

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ILLINOIS TECHNOGRAPH

APRIL
1943

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PLASTICS

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WIND TUNNELS

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Speaking of superior races . . .

Every wheel that rolls on the battlefield turns in a polished bearing race, ruggedly built to take the terrific shock of combat service.

To withstand such punishment, bearing races must be hardened by heat-treatment. Hard and soft spots occasionally occur. Such races may fail—at times when failure means disaster.

Recognizing the vital need, Westinghouse Research Engineers P. H. Brace and C. S. Williams set to work to develop a quick, sure method of detecting these flaws.

Their ingenious electromagnetic flaw-detector is based upon the fundamental law that the *permeability* of a heat-treated steel part varies with the degree of hardness.

In actual practice, Brace and Williams first *completely* demagnetize the bearing race under test. Next it is rapidly rotated and strongly magnetized. While the race is still turning at high speed its magnetic field is explored with a specially designed electromagnetic "pick-up."

Variations in the magnetic field of the bearing race, due to hard or soft spots, induce feeble currents in the pick-up system. These currents are amplified and shown on a cathode-ray oscilloscope.

A uniformly heat-treated bearing race traces a *luminous straight line* on the oscilloscope screen. Faulty heat-treating shows up as a pattern of *hills and valleys*.

The Brace-Williams electromagnetic flaw-detector is now being used commercially—a typical example of Westinghouse *electronics at work*. It assures quality in millions of bearing races for our armed forces, *to keep 'em rolling on to victory!*

★ ★ ★

What Brace and Williams did—by employing Westinghouse "know how" to develop the magnetic flaw detector—many young Westinghouse scientists are now doing in other fields of fundamental research.

Today, they are helping to solve the technical problems of modern warfare. Tomorrow, they will tackle the job of building a better world for all of us.

Westinghouse Electric & Manufacturing Company, Pittsburgh, Pennsylvania.

ELECTRONIC FINGERPRINTS—Westinghouse Research Engineer C. S. Williams demonstrates the principle of the electromagnetic flaw-detector. Hard spots in the steel test piece show up as an irregular line on the oscilloscope screen. Williams joined Westinghouse after receiving his B. S. in Electrical Engineering at Northwestern University.

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Electronics at work

APRIL ★ 1943

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Published Eight Times Yearly by the Students of the College of Engineering, University of Illinois

Published eight times during the year (October, November, December, January, February, March, April, and May) by The Illini Publishing Company. Entered as second class matter, October 30, 1921, at the post office of Urbana, Illinois. Office 213 Engineering Hall, Urbana, Illinois. Subscriptions, $1.00 per year. Single copy 20 cents. Reprint rights reserved by *The Illinois Technograph.*

Frontispiece . . .

Funnels, not for ships but for solvents, these vessels recover volatile fluids used in processing Micarta, from which are made helmets, airplane pulleys, and other plastic forms.

— *Courtesy Westinghouse.*

★

Cover . . .

The 60-ton dipper of a Marion-built electric shovel, as big as any in the world and operated by the Midland Electric Coal Co., is shown with its crew (atop cab) near Middlegroove, Ill., where its strips nearly one million tons of earth a month from coal fields. General Electric motors, generators and amplidyne control equipment enable the shovel to scoop up a freight-car load of dirt in 50 seconds' time. *(Cut Courtesy General Electric).*

Problems in Testing Plastics

By W. N. FINDLEY

Associate in Theoretical and Applied Mechanics

The introduction of plastics as an engineering material has brought to the testing engineer a multitude of new headaches, because there are a number of variables which are of extreme importance in the testing of plastics but are relatively unimportant in the testing of metals. Some of the most important of these variables are temperature, relative humidity, and speed of testing.

A machinist who was given the job of turning a specimen from a sheet of plastic made from laminated paper had a lot of trouble. His lathe tool gouged and chipped the plastic so that the specimen was anything but round. The job gave him a bad day, so that he remarked: "Some people are going too far in trying to make everything out of plastics—especially test specimens! Why the stuff never was designed to be tested in the first place."

This raises a question as to why tests are made. Are tests made only because purchasing agents request them?

There are two main reasons for conducting mechanical tests of materials. The first of these is to provide reliable design data for use in designing machines, structures, or household articles to resist breakage or excessive deformation. A second reason for conducting mechanical tests of materials is to provide a means of inspecting the quality of a material or product and thus to control its uniformity.

The problem of testing materials to fulfill either of the above conditions requires that all variable factors must be controlled which might alter the results of tests. Thus it becomes necessary to study the effect of all variables which influence the results of tests. The effect of variables, such as temperature, humidity, speed of testing, etc. should be thoroughly studied for all materials in order that methods of testing may be made to give reproducable results. Information on the effect of such variables is needed in order to take such variations into account in the design of parts that are being subjected to wide variations in conditions of service.

Types of mechanical tests may be divided into two broad classifications. The first is a utility or non-standard type of test designed to indicate that a given fabricated part is acceptable or is not acceptable. A second type of mechanical test consists of controlled laboratory tests designed to provide basic information on the behavior of the material under loads. A third type of test is intended to provide data for design purposes and may have little bearing on basic properties of the material. Examples of information of the latter type are the bearing strength and shearing strength of materials as used in riveted joints. To provide such data a test may be made of a structure simulating a riveted joint and the rivet shear and rivet bearing strength may be determined from this test.

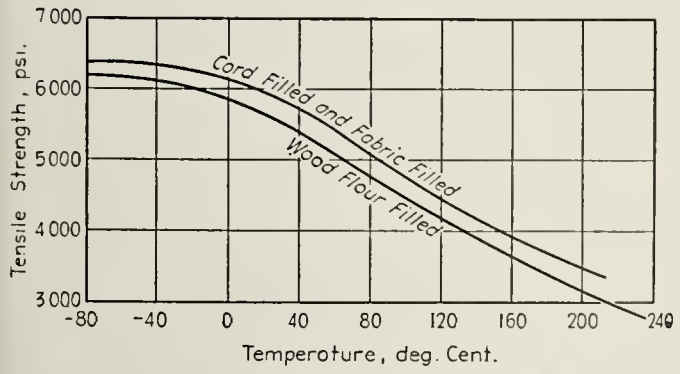


Figure 1. The Effect of Temperature on the Tensile Strength Phenolic Molding Compositions.

"Basic" information on the behavior of plastics under loads together with design data of "non-basic" type is needed because of the application of plastics in parts requiring strength. Some applications in which plastics are used in aircraft for resisting loads instead of purely decorative purposes are as follows: aircraft wing tips, propellers, landing flaps, control tabs, windows, gunner's turrets, engine cowlings, antenna masts, and numerous small parts. Other applications requiring strength are in screens for windows and strainers, pumps and piping for chemicals, parts of electrical relays, punches and dyes for forming

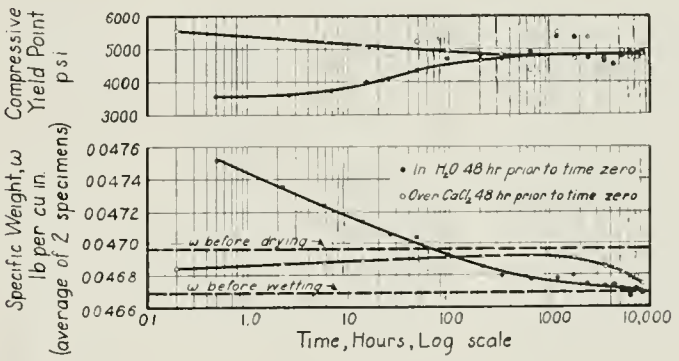


Figure 2. The Effect of Time and Conditioning on the Yield Point in Compression and the Specific Weight of Cellulose Acetate Plotted Against Time.

sheet metal parts of aircraft, army canteens and bugles, and tires to replace rubber on small hand trucks.

Types of tests which are used to provide "basic" information on the mechanical properties of materials are short time tension tests, compression tests, and torsion or twisting tests under steady loads. These are referred to as static tests and indicate the nominal load carrying ability of the material under these types of loading. There are, however, other characteristics which must be investigated because it has been found that both plastics and metals under certain temperatures continue to deform or change their shape under a constant load which may be only a small portion of the load required to cause fracture in a short time test. This phenomenon is called creep and may be disastrous in cases in which the deformation becomes so large as to cause fracture of the material or in case so much distortion takes place as to render the part useless. Tests to determine the susceptability of the material to creep at different temperatures have been devised. They consist in measuring the stretch of a cylndrical rod of the material to which is attached a weight of a given magnitude.

Materials which are subjected to vibration or repeated

bending may develop cracks which grow gradually until fracture takes place. These cracks may occur at repeated stresses which are much less than would be required to cause fracture under a single loading. A progressive fracture resulting from repeated loading is called fatigue.

The Effect of Temperature and Humidity

Plastics are commonly classified into two groups according to their reaction to heat. The first group, called thermoplastic, can be repeatedly softened on heating and hardened on cooling. The second group, thermo-setting materials, undergo a chemical change under heat and pressure which causes the material to become permanently hard and infusable. As might be expected thermo-plastic materials are much more sensitive to small changes in temperature than thermo-setting materials. The effect of temperature changes on the property of a thermo-setting material, methyl methacrylate (Lucite), under both tension

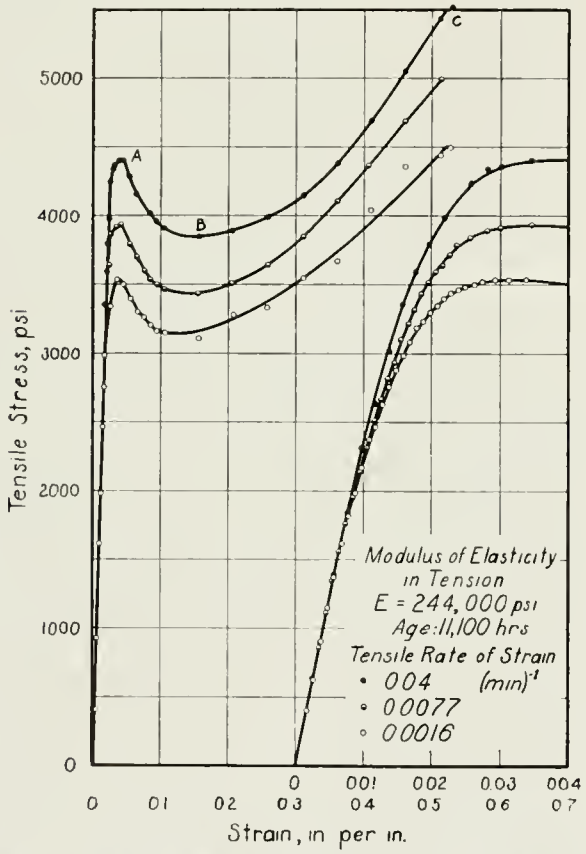


Figure 3. Tensile Stress vs. Tensile Strain of Cellulose Acetate for Three Different Rates of Strain.

and compression loads has been shown by W. F. Bartoe[1]. A change from 68 to 86 F was shown to result in about 15 per cent decrease in yield point in tension and about 17 per cent decrease in yield point in compression. The effect of changes in temperature on the mechanical properties of thermo-setting materials, while less pronounced than for thermo-plastics is still important. A study of the effect of temperature on the strength properties of different phenolic molding compositions is contained in papers by Carswell, Telfair, and Haslanger[2]. With these materials a change from 68 to 86 F resulted in a decrease in ultimate tensile strength of about 4 per cent. *(See Figure 1).*

The effect of changes in moisture content has been studied at the University of Illinois. Figure 2 shows the results of one series of tests in which two groups of compression specimens of cellulose acetate (a thermo-plastic) were subjected to two different humidity conditions[5]. One

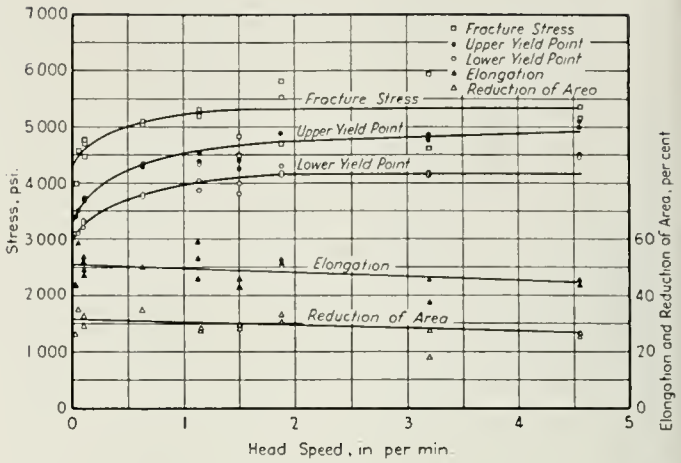


Figure 1. The Effect of Speed of Testing on the Tensile Properties of Cellulose Acetate.

group was placed in a calcium chloride desiccator for 48 hours and another group was immersed in water for a like period. Following this treatment specimens were tested in compression at intervals of time for about 13 months in a room maintained at a constant temperature of 77 F and constant relative humidity of 50 per cent.

Figure 2 shows the yield point from these tests plotted against the duration of time after the humidity treatment[5]. It was noticed that the dried specimens were about 50 per cent stronger that the wet specimens immediately after the drying or wetting treatment, and that about 500 hr. (3 weeks) was required for the two groups of samples to approach equilibrium in an atmosphere maintained at constant temperature of 77 F and constant relative humidity of 50 per cent.

The lower part of Figure 2 shows the change in specific weight of the same group of specimens with time[5]. The change results from a gain or loss in moisture content as

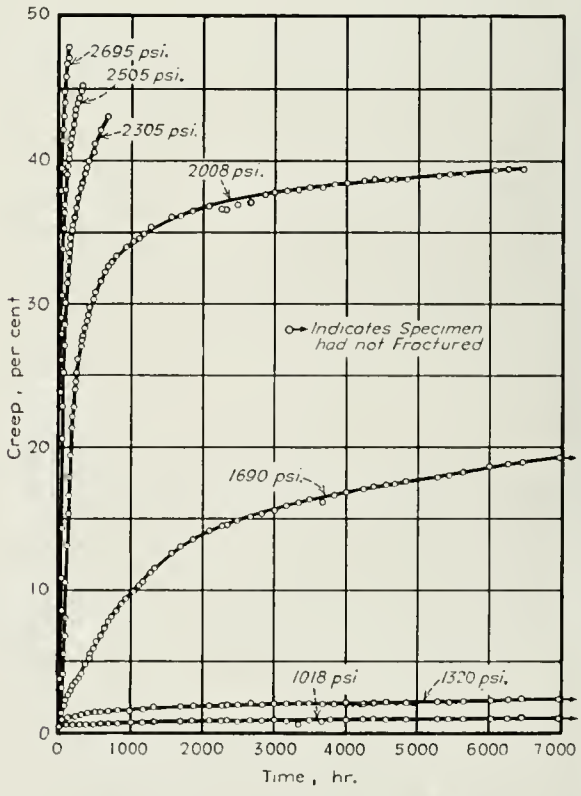


Figure 5. Creep-Time Diagrams for Cellulose Acetate at 77 F and 50 per cent Relative Humidity.

the sample approaches equilibrium with the relative humidity of the testing room. The decrease in weight of the dried specimens beyond 1,000 hr. is due to some unexplained change in the material. It is apparent that for materials of this type representative test results can be obtained only if a period of time about two or three weeks is allowed for conditioning of the material in an atmosphere of constant temperature and constant relative humidity.

Some thermo-plastic materials are, however, quite insensitive to changes in humidity. Polystrene and methylmethacrylate (Lucite) are examples of materials having relatively low response to changes in humidity. Thermo-setting materials show effects similar to that shown for

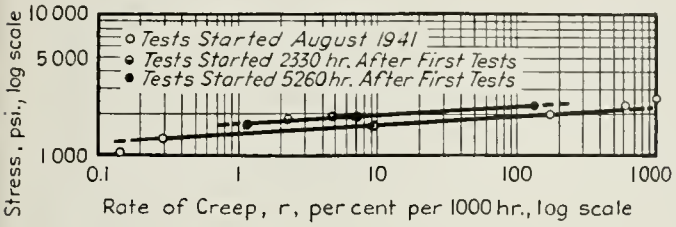


Figure 6. The Effect of Stress on the Rate of Creep of Cellulose Acetate, Log Scale.

cellulose acetate in Figure 2. The magnitude of the effect of variations in humidity on thermo-setting materials, however, depends upon the fillers used in the plastic and the surface conditions.

The Effect of "Speed" of Testing on "Static" Tests

A pronounced speed effect has been found in the "static" tensoin, compression and torsion tests of plastics. This effect is illustrated by the stress-strain diagrams of tension tests of a cellulose acetate shown in Figure 3[5]. These tension tests were performed at three different speeds ranging from 0.021 to 0.32 in. per min., travel of the cross-head of the machine. The corresponding rate at which strain took place in the specimen is shown in the

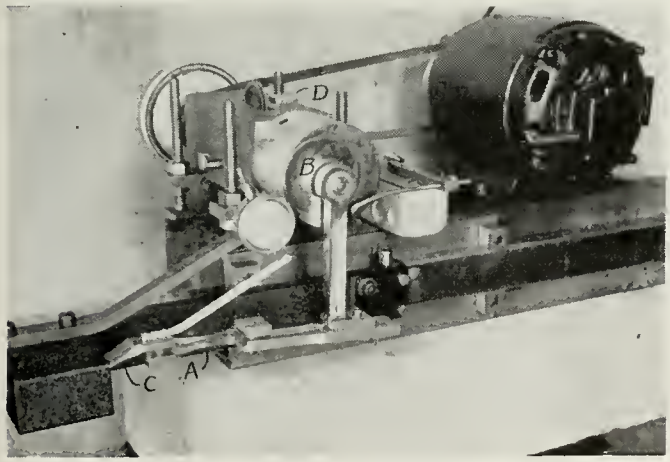


Figure 7. Repeated Bending Fatigue Machine.

figure. These tests show that the measured strength of the material is greater at higher speeds that at lower speeds and that the stress-strain curve deviates from the straight line relation at lower values of stress when the speed is low than when the speed is higher. This deviation from the straight line relation is attributed to the effect of creep which increases the strain readings at low speeds of testing.

The effect of speed of testing on the tensile properties is shown in Figure 4 for a wide range of speeds of testing[5]. In this figure the upper yield point, lower yield point, and fracture stress are plotted against the head speed of the machine. These values are represented by points A, B, C respectively in Figure 3. The data shown in Figure 4 indicates that the strength of the cellulose acetate increases with increasing speed up to a certain point and then remains nearly constant. The ductility as shown by per cent reduction of area and per cent elongation at fracture decreased with increasing speed of testing.

Effects similar to that shown in Figure 4 have also been observed in other plastics and to a lesser degree in metals.

Creep

Many materials, metals as well as plastics, undergo appreciable deformation over a period of time as a result of sustained loads of relatively small magnitude. This deformation or *creep* may continue until fracture takes place if the loads are maintained a sufficient length of time.

While some plastics creep no more than aluminum, cellulose acetate behaves more like soft lead. Figure 5 illustrates the creep of cellulose acetate for different stresses at room temperature 77 degrees F. In this figure creep (the elongation of a tension specimen expressed as a percentage of the original length) is plotted against time[4]. Creep includes both elastic stretch and the continuing deformation.

From Figure 5 it is evident that intermediate stresses (2008 and 1690 psi.) resulted in an initial rapid rate of creep at a nearly constant rate followed by a transition region and then another nearly constant rate of creep. The

(Continued on Page 18)

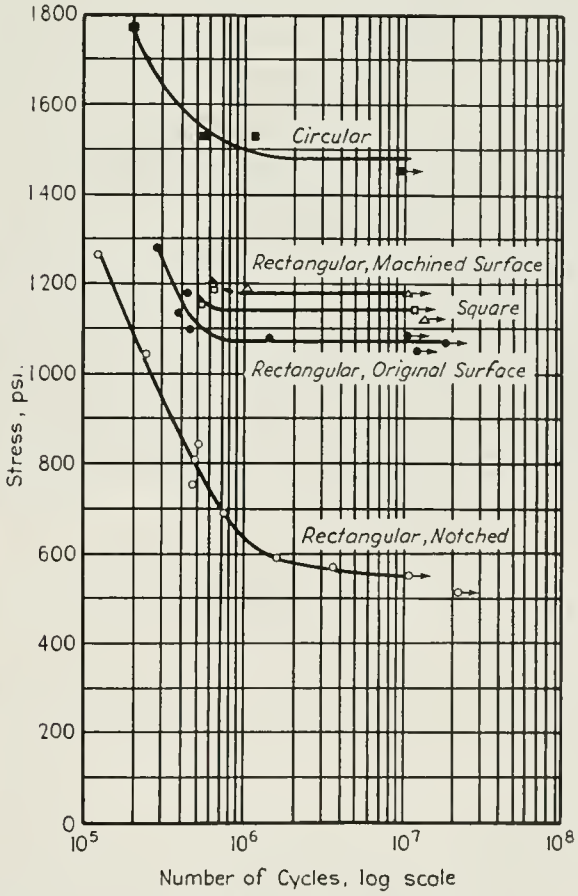


Figure 8. Stress vs. Cycles (σ-N) for Fatigue Tests of Cellulose Acetate with Different Shape Specimens.

WIND TUNNELS VITAL

. . . in Airplane Testing

Wind tunnels at American aerodynamic laboratories often test Army and Navy planes more quickly, better and more easily than human test pilots, Dr. Everett W. Thatcher, co-ordinator of civilian pilot training at Union College, Schenectady, declared in a General Electric Science Forum address in collaboration with the U. S. Army Air Forces.

Dr. Thatcher paid tribute to the fine work being done by the National Advisory Committee for Aeronautics, which last year received appropriations of more than eleven million dollars from Congress. The NACA maintains a big research laboratory at Langley Field, Va., another one at Moffett Field, Calif., and one at Cleveland, Ohio. Other wind tunnel laboratories are maintained by the Army Air Force near Dayton, Ohio; by the Navy, and by some of the large aircraft manufacturers. A few universities and technical schools also have them, according to Dr. Thatcher.

"A wind tunnel is a tunnel, big enough to hold an airplane, in which a powerful wind is generated by propellers," Dr. Thatcher pointed out. "It is used for testing the flying characteristics of airplanes and models of planes. One of the new NACA installations has a wind tunnel that goes up to more than 500 miles an hour."

"The flow of air in a wind tunnel can be charted with smoke and photography," the speaker explained. "Of course, there are many types of wind tunnels of different sizes.

"A wind tunnel is entirely enclosed. You might say that the passage of air in a wind tunnel is a closed circuit. After air has passed by the plane being tested, it is guided back and blown through again. That is the best way to build up a tremendous wind blast and control it.

"Turbulent air currents are different from normal air currents, and often have a different effect on an airplane. But great progress has been made in recent years in smoothing out the air flow in wind tunnels. Then, too, there is the factor of air density.

"For example, if a half-size airplane is being tested, it would not be subject to the same type of air flow as a full-sized airplane in the same air. Engineers solve the problem of compressing the air to twice normal density if they are testing a half-size model. In this way, they can duplicate full-scale effects by changing the density of the air according to the size of the model.

"To test the behavior of a full-size ship flying in a high altitude, the air in the tunnel can be 'thinned-out' by creating a partial vacuum. Workers in these etra-dense or extra-thin atmospheres have to go through decompression chambers just like sandhogs in tunnel construction."

Dr. Thatcher said that the airplane is held firmly by one or more supporters that extend down to a workroom directly below the wind tunnel. The force of the various effects of the air stream on the model are measured accurately by recording scales.

Engineers can predict an airplane's ordinary flying behavior from these measurements, Dr. Thatcher continued. There also is a gadget to measure how the flow of air has been disturbed by the airplane. This is called the wake survey apparatus, and hangs right behind the ship, he explained.

The place where the airship is tested is an open space. Right in front of the plane, the tunnel narrows down like a huge funnel. Right behind the plane, the tunnel picks up the air again with a flared opening.

The machine being tested is right in the full blast of the wind, according to Dr. Thatcher.

"There are smaller wind tunnels for special purposes, such as high-velocity tunnels for studying propellers," he pointed out. "The new super-sonic tunnels have a speed of more than 1000 miles an hour. And then, there are vertical tunnels for testing the spinning characteristics of small models."

"This wind tunnel work is not only important," Dr. Thatcher asserted, "it is vital in securing the most efficient aircraft for the Air Forces and well worth the cost and trouble. Now that we are at war — and long before, for that matter — the main emphasis has been on fighting aircraft for the Army and Navy."

One of the purposes of the wind tunnel is to give a positive check on the design of American airplanes, the speaker explained.

"You see," Dr. Thatcher explained, "an airplane can be planned by the best scientific brain in the world and appear perfect on paper, but the only way to check up on it, as with an automobile, a ship, or any other mechanical device, is by use.

"Testing is done by test pilots, but often it is quicker, better and easier to make these tests at an aerodynamic laboratory."

He said that before a new type of airplane goes into production, before a full-sized one has even come out of the factroy, the designers take a model of the projected ship and test it in the wind tunnels. In this way, Dr. Thatcher said, engineers know that an airplane is pretty close to being aerodynamically right before it has even been built.

"The main purpose of the wind tunnel is the elimination of drag," Dr. Thatcher continued. "We might call it the entire burden that must be overcome by the thrust of the propeller as the ship moves through the air."

He commented on one of the parasite drags.

"In a high-speed ship, even the smallest irregularity of the surface can cause a lot of skin friction," he said. "At Langley Field it was found that a coat of spray paint on the wing surface of a transport ship at 225 miles an hour decreased the ship's performance a great deal. In effect, it robbed the transport of 91 horsepowers as compared with a smoothly polished wing surface.

"The same thing applies to rivets, joints, knobs, and so forth, although you do not see any unnecessary projections like those on high-speed planes any more. Even fine grain sand, only five ten-thousandths of an inch, was found to exert a noticeable drag when put on a wing surface."

Nowadays, engines are always enclosed in a metal cowling devised by the NACA, Dr. Thatcher declared. By reducing the air resistance caused by the engine, and presenting a smoother surface to the air, the speed has been increased many miles an hour.

And the NACA also worked out a wing-shape formula that is just about universal the world over," the speaker added.

Dr. Thatcher said in conclusion that "as far as we know, no nation on earth can match the equipment and aeronautical research that go into the job of making American fighter planes and bombers the fastest and best ships in the air."

Every branch of the Armed Services uses the telephone. No. 2 of a series, Submarine.

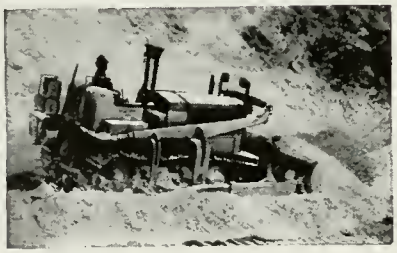
Five thousand miles from home Bill—Torpedoman—is keeping a date. Weeks of waiting, days of watching, hours of hiding under the sea, all for the moment when he reports over his wartime telephone, "All tubes ready, sir!" There'll be other dates, Bill—better ones—in the kind of world you're fighting for.

Western Electric

IN PEACE...SOURCE OF SUPPLY FOR THE BELL SYSTEM.
IN WAR...ARSENAL OF COMMUNICATIONS EQUIPMENT.

PUMPING LEAD...

Night Fighter in Action! Allis-Chalmers equipment is helping the U.S.A. build and arm 185,000 planes in two years!



A-C Tractors and Bulldozers help build roads and air fields.

Allis-Chalmers equipment helps make cloth for Army and Navy.

Metal for Bullets, Machine Guns, Planes...Water Supp for Cities—flow from Allis-Chalmers Equipment!

BULLET LEAD for Night Fighters is mined and refined with the help of Allis-Chalmers equipment.

So is *steel* for guns—*aluminum* for wings!

And great pumps which deliver tons of precious water to America's cities are also among the *1,600 Allis-Chalmers products.*

The thousands of Allis-Chalmers employees in 8 great plants are proud that their effort aids production in *every* major U.S. industry.

And in 65 cities Allis-Chalmers engineers are on call to help you produce *more*—not just with new machines, but with machines *now on hand!*

ALLIS-CHALMERS MFG. CO., MILWAUKEE, WIS.

New Allis-Chalmers turbines add U.S. Industry's growing power.

ALLIS-CH

OFFERS EVERY MANUFACTURER EQUIPMENT AND ENGINEERING

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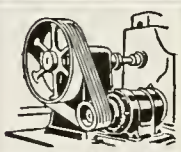
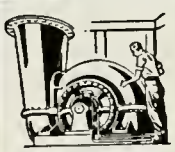
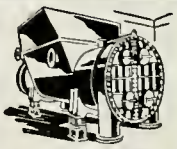


MOTORS & TEXROPE V-BELT DRIVES



BLOWERS AND COMPRESSORS



ENGINES AND CONDENSERS

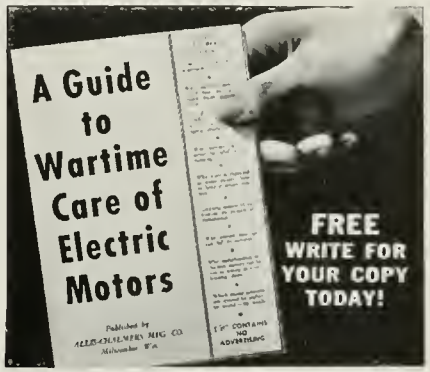
CENTRIFUGA PUMPS

ater for Millions! Allis-Chalmers pumps help keep many of America's cities alive.

VICTORY NEWS

A New Fleet of Tugs is being built for the U. S. Navy. Their principle duty is long towing of disabled vessels in rough seas.

The most powerful of their kind in the world, most of the tugs will be driven by Allis-Chalmers electrical propulsion equipment. Their electrical equipment includes Allis-Chalmers motors, generators and control.



New Handbook on Care of Motors. With motors operating 168 hours a week instead of 40 hours as formerly, most books on motor care are seriously out-of-date.

A new handbook entitled "A Guide to Wartime Care of Electric Motors" has just been published by Allis-Chalmers. It takes a new slant at motor care and is of great value to war plant engineers and maintenance men, and particularly for training new men. *The book contains no advertising, and is available upon request.*

Rush A-C Tractors to World Battlefields. Thousands of gun-pulling Allis-Chalmers track-type tractors will soon see action in Russian and U.S. Forces overseas. These tractors differ from Allis-Chalmers regular commercial models only in additional equipment carried. The army version of this tractor is also speeded up somewhat over the commercial model.

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Buy United States War Bonds

ALMERS

WE WORK FOR VICTORY — WE PLAN FOR PEACE

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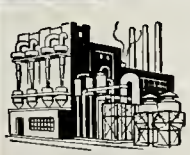

Our Societies . . .

By BYRON M. ROBINSON, M. E. '44

A.S.M.E.

On Monday April 5, Paul Salerno and Walter Gailus presented technical research papers on Ejector Pumps, and Plastics, respectively, to the A.S.M.E. in a competition, the winner of which was Walter Gailus who was sent to Northwestern University on April 10 where he represented the University of Illinois by again presenting his paper in competition against other mid-western college winners.

PI TAU SIGMA

Fourteen students were initiated into Pi Tau Sigma on Sunday April 11, at 5:30 p. m. At six o'clock, an initiation banquet was held at the Inman hotel, with Mr. M. J. Goglia as toastmaster. Welcome to the new initiates and to guests was given by Steve Yurenka who was answered by Carl Brown who spoke for the initiates. Speaker for the evening was Mr. W. L. Abbott, who, although now retired, was for fifty years the Chief Operating Engineer of Commonwealth Edison, and also a member of the Board of Trustees of the University of Illinois. Mr. Abbott spoke on the subject "Coal and the Hereafter."

TAU NU TAU

Formal intiation of five "sappers" was held Sunday morning, March 28, at seven o'clock at the University stables. No informal initiation was held this year as has been the custom in the past. A regular meeting was held March 30 at Triangle fraternity. Prof. Jamison Vawter was the guest speaker. He spoke on the construction of bomb-proof shelters which is of special importance to the military engineer. Due to difficulties brought on by the war, plans for a maneuver have been dropped for this semester.

A.S.C.E.

On April 1, in 319 Engineering Hall, Prof. H. E. Babbitt spoke to the A.S.C.E. His topic was appropriately "The April Fool." The meeting was well attended, and very entertaining. The following committee chairmen were announced: Erwin Mueller, Program; Bill Ogden, Attendance; Sheldon Leavitt, Publicity; and Dick Webster, Social.

SIGMA TAU

The current belief among L.A.S. and Commerce students that engineers are not at home without a slide rule was disproved at a Sigma Tau smoker on Sunday evening, March 28, at the AKL fraternity house when actives and rushees let down their hair and demonstrated skills ranging from P.E. stunts to threading needles in a good old fashioned game of "Truth or Consequences." Facultymen were stumped along with the rest on the stiff questions, and everyone bravely suffered the consequences. During the first week in May, the annual spring initiation will take place.

CHI EPSILON

The annual spring initiation of Chi Epsilon was held on Tuesday evening, April 13, 1943 in the Union Building. The following students became active members: Joseph V. Dust, Neal Houbolt, Robert D. Mahan, Elmer L. Major, Jr., and Robert A. Sproat.

Dean Harvey Herbert Jordan was also initiated as an honorary member of the chapter. Dean Jordan first served as an instructor in general engineering drawing at the university from 1911-15 and as an associate from 1915 to 1917. He was appointed Assistant Dean of the College of Engineering in 1917, holding this position until 1934, at which time he became Associate Dean.

The spring picnic of Chi Epsilon will be held on Tuesday afternoon, April 27, 1943, at Hessel Park. A softball game promises to be the main feature.

TAU BETA PI

Due to limitations caused by the war, the spring initiation banquet progressed from dinner in the Federal and Gothic Rooms of the Union Building to the faculty lounge for the after-dinner speeches.

The group initiated was: John A. Bell, Richard J. Divilbiss, Lowell C. Gibson, Warren Goodell, Ralph Greenberg, Sheldon Leavitt, Gordon McClure, Charles McVey, Norman Millet, Erwin Mueller, Benjamin Muirheid, Harold Schick, Emanuel Schnitzer, Harold Schwellensattl, Robert Shapland, Carl Staben, Robert Turner, Veikko Viitanen, Burnham Walraven, Robert Whitaker, and Robert Wunder. Professor N. M. Newmark was initiated for the Beta Chapter of New Jersey at Rutgers.

KERAMOS

Keramos held a smoker on Thursday, April 8, in the Union Building. Eight prospective members were invited to the meeting. After Prof. R. K. Hursh reviewed the history and benefits of the society, he showed slides of ceramic plants that he has visited. Following this meeting, the regular members discussed plans for pledging.

A.I.E.E.

On March 25, 1943, D. E. U. Condon, associate director of the Westinghouse Research laboratories, East Pittsburgh, Pennsylvania gave an interesting lecture on "Micro-Wave Electronics." Dr. Condon discussed the use of radio waves at wave lengths between one meter and one centimeter, the use of wave guides, and the laboratory technique used for the study of these radio waves. The lecture was sponsored jointly by the Urbana section, and the student branch of the A.I.E.E. Members of the A.S.C.E., A.S.M.E., and faculty and students of the physics department attended the lecture.

S.B.A.C.S.

The new officers of S.B.A.C.S. for the year 1943-44 are as follows:

Gordon Johnson ..... *President*
Morris Klimboff ..... *Vice President*
Haraldur Asgeirsson ..... *Secretary*
Jim Griffith ..... *Treasurer*

A very interesting "Speaking Contest" was held on the evening of March 30. The contestants, members of the Student Branch, were judged on manner of presentation as well as on material presented. Payson Shonkwiler's talk on "Calcium-Aluminate Cements" was judged as the best of the evening.

The annual convention of the American Ceramic Society was held in Pittsburgh on April 18 to 21st. The main topic discussed was "The War and the Industry."

Combining PATRIOTISM *and* GOOD SENSE

Of course every one is willing to do without the essential materials that help win the war; everybody knows zinc and steel are among those materials. And *of course* it is just good common sense to take care of the things we have, including galvanized roofing, to make them last as long as possible and give the best service.

HOW TO CONSERVE GALVANIZED ROOFING

You'll find galvanized roofing of various types used on all kinds of structures, on farms, in industrial plants, in housing. It is a valuable material, and with proper care it can be made to last a long, long time; anyhow, until the war is over and necessary replacement material is available.

Galvanized sheets constitute one of the most popular forms of roofing for farm buildings of all kinds. Everything considered, they are also the most economical.

Do This . . .

See that all the roof supports are in good shape. If necessary renail and strengthen them, and replace broken or rotted members.

And This . . .

Then bring all the separate sheets into as close alignment as possible. If moisture has a tendency to creep through at the laps, lay a strand of asbestos wicking between the sheets at the laps, and renail the roofing with an approved type of zinc-coated lead-seal special roofing nail with a drive-screw shank. Stubborn lap openings can be effectively closed with hardware screws.

In industrial establishments, where efficiency and economy of materials are of prime importance, galvanized sheets are widely used for various types of structures, from modest homes for employees to the largest of manufacturing plants.

And This . . .

If any of the roofing is showing signs of rusting, paint it with two coats of metallic zinc paint, (see Federal Specifications TT-P-641) which will effectively stop the rust and prevent further injury to the roofing. In fact, the use of this remarkably good paint, which can be readily made by any paint manufacturer, will extend the life of galvanized roofing almost indefinitely.

In "How To Make Galvanized Roofing Last Longer", a booklet published by the Institute, complete and explicit directions are given for all of the above operations. Copies will be sent free upon request.

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Our Engineering Library

By PAUL SALERNO, M.E. '43

The engineering students at the University of Illinois are fortunate to have access to a really fine library. The Engineering Library, located on the first floor of Engineering Hall, contains more than 47,000 volumes. This is increased at the rate of over 2,000 volumes each year.

The material available in our library may be divided into the following groups:

1) Textbooks.
2) Engineering Handbooks. The library contains practically every engineering handbook published.
3) Reserve books for various courses.
4) Reference works, including such works as year books, technical dictionaries in foreign languages with definitions in English, biographical dictionaries, and law books.
5) Magazines.
6) Publications of all the major engineering societies and practically all of the minor societies. This group constitutes an important part of the library.
7) Experiment station bulletins from most of the colleges in the country.
8) Browsing collection of popular books.
9) Documents.
10) Foreign Publications.

Since every new development in the field of engineering is first described in a technical journal, it is advisable for the student to become acquainted with this type of publication. The library receives over 450 technical periodicals, and bound volumes for any year may be obtained at the desk. Current issues are found in a rack at the south end of the room. Here also will be found the "Industrial Arts Index," and the "Engineering Index." These indexes are issued yearly and list all magazine articles on any particular subject which was published during the year. Suppose, for example, that one were interested in recent developments in the field of vacuum tubes. Looking in the 1942 issue of the "Industrial Arts Index," he will find references to almost a hundred articles on this subject. About seventy more recent articles, which were published during the first three months of 1943 are listed in the current issue of the index. The references are listed under various headings, such as Control uses, Measurement uses, Industrial applications, Scientific applications, Testing, etc.

The library contains an excellent collection of aeronautical literature. All books which are recommended for Army and Navy air corps cadets are available. Any student interested in aviation will find that he can obtain practically any information he wishes, short of military secrets, of course. "Aerosphere," an annual publication, contains the latest information concerning planes, armament, and engines of all countries. In fact, this particular book contains such important material that Uncle Sam keeps a record of the names of all persons who purchase it. Another authoritative reference book is Jane's "All the World's Aircraft." The latest information pertaining to all phases of aviation i. e. Civilian Pilot Training, military pilot training, aircraft manufacturers, engines, planes, etc., can be found in the "Aircraft Yearbook." Jordanoff's "Illustrated Aviation Dictionary" and many other books are available. The aeronautical publications listed agove are conveniently located at a desk in the northwest corner of the library. Jane's "Fighting Ships," which contains information on warships of the world in astonishing detail, and the "Locomotive Cyclopedia" are also found here.

The library maintains a "New Book Table" upon which are kept the very latest books received. Some of the titles seen here at the present time are: "Plastics Catalog," "Aircraft Instruments," "Aero Engineers Manual," "Astro-Navigation," etc.

The library is an excellent place to study since it is very quiet and possesses a very restful atmosphere. Reading tables are located on the second floor as well as on the main floor. Located here are bound volumes of many periodicals. A conference room is available where a group of students may go to discuss problems.

Several exhibits and photographs of interest to engineers are on display and an examination of these will be profitable. One of the largest exhibits illustrates the production and uses of aluminum.

With all the advantages that our library offers, students ought to make full use of it. The library will help you make the most of your academic career and offers opportunities which will probably not be available after leaving school. Do not hesitate to ask for assistance because Miss Alseth and her staff are capable and willing to help you.

INSTRUMENT MAKES BLIND PLANE LANDING POSSIBLE

By means of two sets of radio signals, a pilot can now land when the ceiling is zero. The instrument contains two pointers, one vertical and one horizontal, which cross over a small dot on the dial when the course is correct. Westinghouse engineers state that the radio signals sent out from the field control the pointers. One signal keeps the plane on the course leading to the field; the other signal keeps the plane on the correct gliding angle. The instrument is shock-resistant, ultra-sensitive and immune to temperatures 50 below to 130 degrees above zero.

CHROME-PLATED CUTTING EDGES

Production on war work has been speeded, tools produced through regular labor-management meetings at the Westinghouse East Springfield works. One sub-committee reported saving time and material by applying hard-chrome plating to the cutting edges of tools and punches. One particular tool in use on all three shifts had to be ground once or twice each shift or an average of four to five grinds per day. In addition to time lost, valuable steel was ground sway each time. This same tool, after a .0002-inch chrome film had been properly applied, performed perfectly for seven three-shift days before regrinding and replating were necessary.

TWO WAYS TIN IS SAVED

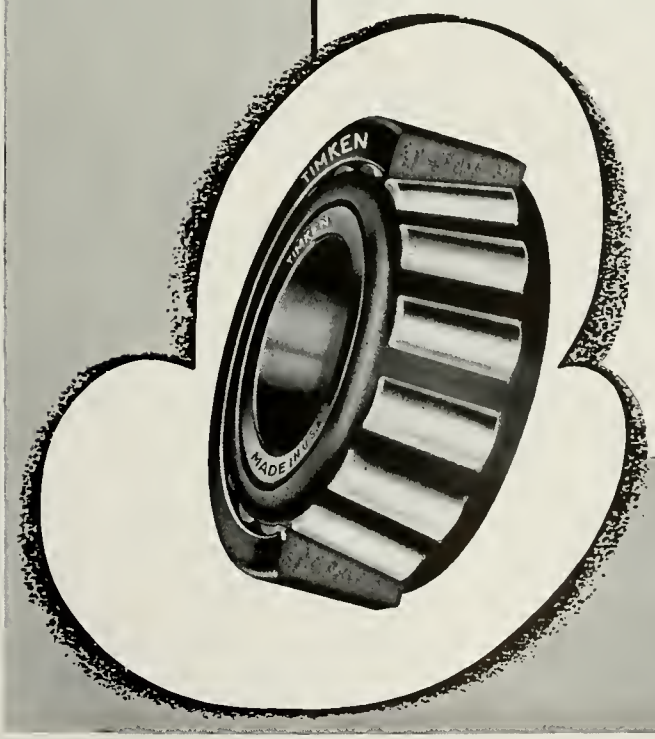
We all have wondered how much tin is saved through turning in our old toothpaste tubes. Authorities reveal that during October these old tubes yielded 80 tons of tin. Westinghouse engineers also save tin through a new plating process which is used, instead of the old dipping method, in making tin plate.

Engineers who know their bearings are helping to win the war. Take a tip from them for your future's sake.

No matter how well a machine is designed in other respects it cannot operate with maximum efficiency if its bearings are unequal to the tasks assigned to them.

For example, friction elimination is only one function of bearings in modern mechanical equipment. Equally imperative and important are ability to carry and control radial loads, thrust loads and any combination of them; to hold moving parts in correct and constant alignment; and to adapt themselves to any condition of application without the slightest reduction of efficiency in any respect.

Timken Tapered Roller Bearings have a success record covering more than 44 years and embracing every kind of equipment used in industry and transportation as well as modern weapons of war, including tanks, trucks, armored cars, guns, airplanes and warships.



With a thorough knowledge of Timken Bearings at your command you never will be confronted with a bearing problem you cannot solve. Begin to acquire this knowledge now. Timken Bearing specialists will be glad to assist you. The Timken Roller Bearing Company, Canton, Ohio.

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TAPERED ROLLER BEARINGS

"All there is in Bearings"

PROBLEMS IN TESTING PLASTICS

(Continued from Page 9)

creep in the latter region had a lower rate of creep than at first.

The effect of different stresses on the creep of cellulose acetate is better shown by a logarithmic plot, Figure 6, of the stress against the rate of creep in the first region[4]. This diagram is seen to represent a straight line so that it is possible to express the relation between rate of creep, r, and stress, σ, by a simple equation

$$r = 1/1440\ \sigma^{15.4}.$$

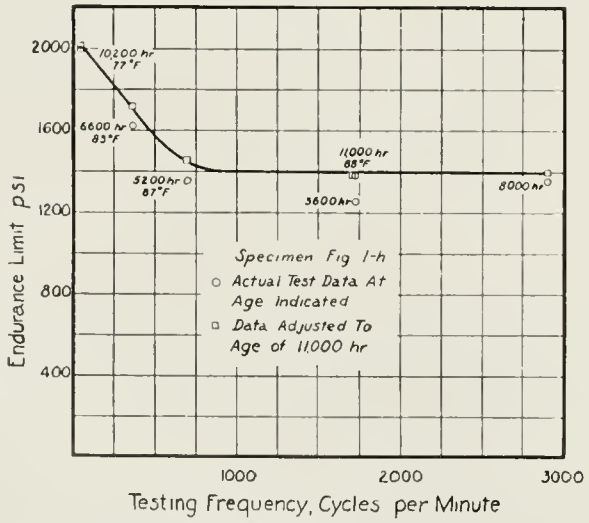

Figure 9. The Effect of "Speed" of Testing on the Endurance Limit of Cellulose Acetate in Fatigue.

Fatigue

The phenomenon of fatigue or progressive fracture resulting from repeated loading has been studied by means of machines designed to produce repeated loadings of various types. A series of fatigue tests of cellulose acetate has been conducted on machines such as shown in Figure 7[3,5]. This machine is a constant amplitude type of bending fatigue machine. In such a machine the specimen A is repeatedly bent back and forth as a cantilever beam by the variable eccentric B. The bending moment in the specimen is determined from the calibrated dynamometer C Figure 7. The stress can then be computed from the bending moment. A counter D records the number of cycles of loading to which the specimen is subjected before fracture. Thus for each specimen placed in the machine the stress corresponding to the deflection of the specimen during the test is calculated from the bending moment, and the number of cycles for fracture is obtained. These data are then plotted with stress as ordinate and number of cycles as abscissa using semi-logarithmic plotting. The

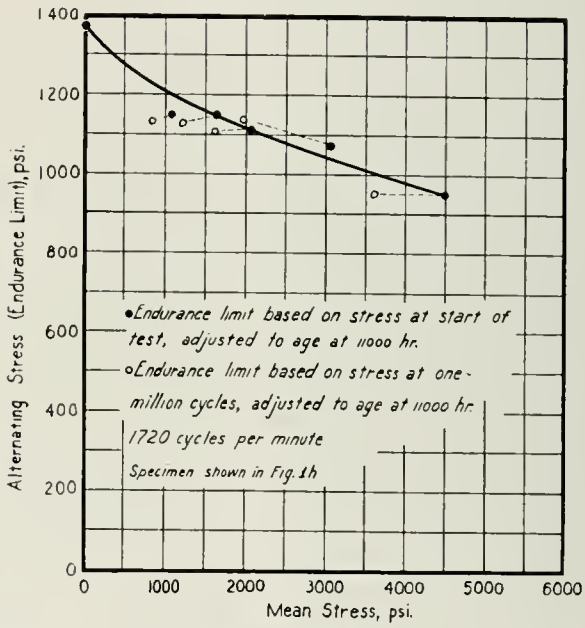

Figure 10. The Effect of Mean Stress on the Endurance Limit of Cellulose Acetate in Fatigue.

resulting curve is known as the σ-N diagram.

For cellulose acetate a well defined endurance limit was found as shown by the fact that the σ-N diagrams for cellulose acetate in Figure 8 have a knee at about one million cycles[3]. A stress below the value at the knee of the curve does not produce fracture for an indefinitely large number of cycle of stress.

Figure 8 indicates that the indurance limit of cellulose acetate is markedly altered by change in the shape of the test specimen[3,5]. A sharp V-notch caused a reduction of about 50 per cent over the endurance limit of a specimen having a rectangular cross-section. Specimens having a circular cross-section gave an endurance limit about 30 per cent higher than the rectangular cross-section. The difference between the notched and rectangular specimen is attributed to the high stress concentration at the root of the notch. No satisfactory explanation is known for the difference between circular and rectangular specimens.

Effect of Speed of Testing on the Endurance Limit

Different speeds of fatigue testing have been found to yield different values of endurance limit in plastics—a fact

(Continued on Page 20)

A quick trim for a metal giant

MAMMOTH ingots of steel for war weapons must be "cropped" or trimmed at the ends before forging. Formerly this job was done slowly and laboriously on a heavy press, but today the huge ingots are sliced neatly and quickly by the oxyacetylene flame.

Using a new heavy cutting technique developed by Airco Research Engineers and cutting through metal as thick as 36", the oxyacetylene flame trims off both ends of this ingot at once in approximately 11 minutes, compared to several hours required by other methods. The new ingot cutting machine designed and built by Airco engineers especially for this job guides the movement of the oxyacetylene cutting torches in an arc corresponding to the ingot contour.

This new flame cutting application typifies the ever-expanding usefulness of the oxyacetylene flame in American industry. Spurred by the need for swifter war production, industries are finding more and more ways to accelerate manufacturing with oxyacetylene flame and electric arc processes.

If you want to keep posted on some of the most recent developments and applications of oxyacetylene flame and electric arc processes, write for a free copy of the illustrated booklet, "Airco in the News." Please address your requests to Air Reduction, Room 1656, 60 East 42nd Street, New York.

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TAPES . RULES . PRECISION TOOLS

PROBLEMS IN TESTING PLASTICS

(Continued from Page 18)

of importance when one considers that the same type of material may be used in a propeller with high frequencies of vibration, and an aircraft wing with low frequencies of vibration.

The effect of speed of fatigue testing on the endurance limit of cellulose acetate is shown in Figure 9[3]. This diagram shows that the endurance limit decreases as the speed of testing increases up to about 750 cycles per min. Above this speed the endurance limit remains nearly constant.

Effect of Range of Stress

In the fatigue tests mentioned above, the stress cycle was completely reversed i.e., the specimen was bent the same amount in both directions so that the maximum compression stress in a cycle was equal to the maximum tension stress. This is frequently not the case, however, in service. A propeller, for example, is subjected to tension stresses resulting from centrifugal forces. In addition stresses are set up due to vibration of the propeller blade. This vibration causes a repeated stress which changes in magnitude but is not completely reversed. It is always tension.

A cycle of stress may be resolved into two components a constant or *mean* value of stress and an *alternating* stress. For example the mean stress in a propeller is caused by the centrifugal forces (plus aerodynamic forces) and the alternating stress is caused by vibration. For the fatigue tests mentioned above the mean stress was zero, and the endurance limit was the magnitude of the maximum alternating stress which would not cause fracture after an indefinitely large number of cycles. When the mean stress is not zero the corresponding value of maximum alternating stress which will not cause fracture may be defined as the endurance limit of the material for that value of the mean stress.

The endurance limit of cellulose acetate is plotted against the mean stress of the cycle in Figure 10 for several values of mean stress[3]. These data show that the endurance limit decreases with an increase in the mean stress of the cycle, when the mean stress is a tension stress.

Relation of Tests to Design

Unfortunately the results of laboratory tests can be applied directly to a design problem only in the case of very simple structures. Designers are not yet able to solve design problems completely when all the variables are included. Nor have testing engineers yet been able to evaluate the effect of all factors which influence the properties of materials. Until such a time as it becomes possible to evaluate the effect of all variables in terms of a rational design, it is necessary to correlate results of laboratory tests with service tests before the full meanings of laboratory tests of a material are established.

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Something for you to do, afterward?

A MESSAGE TO MEN ON COLLEGE CAMPUSES

At no time in all the years we have been the confidant of young men approaching a career have we been so sure of the opportunity implicit in your future.

Today, your campus may not be of your own choosing. Your courses, your schedules almost all are pointed toward immediate necessity. Your career is set.

Have you a true conception of how much your special training means to your country? To Victory?

We think you do. But, honestly, don't you catch yourself wondering whether there is really going to be something for you to do, afterward? Are you sometimes in doubt of what's to come after NOW?

We say to you: There is a world to be made anew.

That world is going to offer you creative opportunity surpassing anything we old-timers have ever seen. You are going to have tools and materials and knowledge to work with such as no generation ever had.

We think you are going to find not only a country, but a whole world, waiting for your talents.

And we know that in this country you are going to find a point-of-view throughout industry which is a new thing under the sun. Already countless leaders in industry are laying plans which are based on flat acceptance of the principle that their first responsibility, after all-out production for war, is to make postwar jobs.

We at Alcoa are one group of such men. We are Imagineering now, for you. We intend to do everything we know how to make aluminum make jobs, whether they may be with us, or in a thousand other industries which will be using Alcoa Aluminum when it is again available.

Wherever you are in service, you will surely be in, or around, or supported by, American airplanes. Will you remember two things: They are made largely of Alcoa Aluminum. *And,* the folks who make that metal are even now Imagineering for your future.

A PARENTHETICAL ASIDE: FROM THE AUTOBIOGRAPHY OF

ALCOA ALUMINUM

• This message is printed by Aluminum Company of America to help people to understand *what we do* and *what sort of men* make aluminum grow in usefulness.

FREE! *102 PAGES OF INFORMATION AND DATA ON SEAMLESS & DROP-FORGED STEEL PRODUCTS*

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HARRISBURG STEEL CORPORATION

HARRISBURG, PENNSYLVANIA

Who have been awarded the Army-Navy "E" for high achievement in production

What is an Electronic Device?

An electronic device is one in which the electron is set free from the atom nucleus around which it ordinarily revolves, according to Dr Joseph Slepian, associate director of the Westinghouse Research Laboratories. A copper wire is not an electronic device because its electrons are only partially separated from their atoms. Electrons wander from the neighborhood of one neucleus to the neighborhood of another, but they are never farther than a billionth-of-an-inch or so away from the center of any atom. In the radio tube, which has been pumped free of air and other gases, the separation between electron and atom is approximately 10,000 times greater than in the wire. Therefore, the radio tube is truly an electronic device.

Fluorescence and Phosphorescence

The two terms "fluorescence" and "phosphorescence" are sometimes confused. They both represent the ability of certain substances to transform some form of energy into visible light. The results are indistinguishable to the eye, but between them there is one important difference. Fluorescence lasts only while the exciting energy source or ultraviolet "black light" is present; phosphorescence continues after the light has been removed.

Lightning Goes Down, Then Up

Lightning bounces upward from the ground along a heated path 200 times as fast as it flashes downward from the clouds, Charles F. Wagner of Westinghouse recently pointed out to the Academy of Science and Art in Pittsburgh. The most brilliant part of a lightning stroke moves upward from the earth to the cloud at a speed of 20,000 miles per second — fast enough to make a round-the-world trip before you can draw a deep breath. The downward drive of the stroke is at the rate of only 100 miles a second, and its light is so feeble that it often fails to make any impression on photographic film. The luminous upward stroke moves along a highway of ionized air established by the earlier stroke from cloud to ground. Since only a few ten-thousandths of a second separate the two strokes, the human eye sees them as one.

Weighs Oxygen Atoms

A single layer of oxygen atoms on a sliver of steel the size of a safety razor blade can be weighed by a sensitive balance in the Westinghouse Research Laboratories. Such a layer weighs two hundred-millionths of an ounce, or about a hundredth as much as a speck of pepper.

THE WINGED INGOT is a symbol of freedom. It is a graphic expression of Dow's recovery of magnesium, lightest of the light metals, from sea water to release our airplanes from hampering weight.

Also, it is a symbol of things to come. When peace returns the freedom of American enterprise will permit the full use of Dow's vast magnesium production to speed transportation of passengers and freight by air and lighten tasks in industry, business and the home.

Millions of pounds of Dow magnesium, extracted from the inexhaustible sources of the sea and from Michigan brine—as well as Dow facilities already established for the fabrication of Dowmetal castings and wrought products—will then be available to give this symbol of freedom—the flying ingot—its fullest significance.

THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN

New York—St. Louis—Chicago—Houston—San Francisco—Los Angeles—Seattle

MAGNESIUM

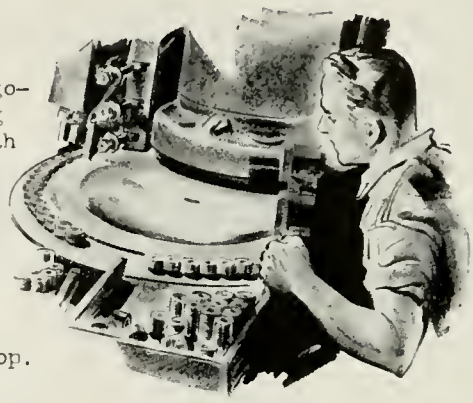
PRODUCER SINCE 1916

DOW

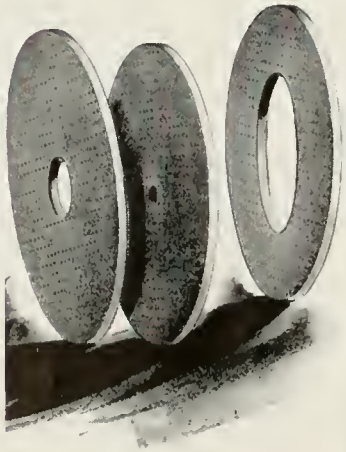
CHEMICALS INDISPENSABLE TO INDUSTRY AND VICTORY

This Merry-go-round has gone to war!

1. It takes a lot of parts to make a Jeep. And this "merry-go-round" has the job of grinding some of those parts (those with flat surfaces)...in a hurry! By rotating a large number of pieces beneath a Carborundum made disc wheel, it surface grinds them in a fraction of the time required by older methods. This process is one which Carborundum helped develop.



2. Surface ground parts for jeeps, tanks and other weapons just couldn't be finished one at a time; production would be hopelessly low. The introduction of disc wheels and the "merry-go-round" surface grinder put surface grinding on a real mass production basis. The method can be used to generate flat surfaces to precision tolerances, on smallest pieces or on massive forgings and castings. It speeds production of many vital war items from valve springs to connecting rods, from piston rings to clutch plates!



3. You'll come to know Carborundum-made products well when you take your place in industry. Whenever you encounter a problem abrasives might solve, please feel free to call on us. The Carborundum Company, Niagara Falls, New York.

CARBORUNDUM
REG. U.S. PAT. OFF.
ABRASIVE PRODUCTS

"Carborundum is a registered trade-mark of and indicates manufacture by The Carborundum Company."

The Goblin that works for America

THE INQUISITIVE alchemists of the Middle Ages were looking for silver. Repeatedly, they smelted certain ores and got a silvery-looking metal. But it was only *silvery-looking*. It never turned out to be silver. So the alchemists thought that a malicious spirit was thwarting them, and they called the strange metal Kobold, meaning goblin.

Today that same goblin, known in America as cobalt, has become one of this country's great fighting elements. Cobalt is alloyed with chromium and tungsten to make "Haynes Stellite" alloys which have the property of "red hardness." Metal-cutting tools made of these alloys keep on cutting even when red hot! Cobalt improves red hardness and toughness in other kinds of metal-cutting tools. Thus, cobalt has contributed greatly to the tremendous output of planes, tanks, guns, and other war materials.

Cobalt is also used to produce improved magnet steels. Permanent magnets of cobalt-tungsten steel are more powerful, and last longer. Permanent magnets are necessary in much electrical equipment.

This country's cobalt formerly came from Belgium, where it was refined from African ores found in the Belgian Congo.

As war clouds loomed, and as accelerated American industry made rapid inroads on the stockpiles shipped out of Belgium during 1938 and 1939, ELECTRO METALLURGICAL COMPANY, a unit of UCC, designed and built facilities in this country for the Belgians. ELECTROMET now operates these facilities so that HAYNES STELLITE COMPANY, another Unit of UCC, and other American companies can have the cobalt they need for essential war work. Operations began in 1941. Today, these facilities annually produce more cobalt than was ever imported in any year previously.

BUY UNITED STATES WAR BONDS AND STAMPS

RED HOT...STILL CUTTING! Faster production of metal equipment of all kinds is made possible by high-speed metal-cutting tools containing cobalt.

SIGHTED SUB! Better radio transmitting tubes and improved electrical equipment are assured by cobalt.

CALLING HEADQUARTERS! Telephones and other electrical equipment require permanent magnets. The better magnet alloys contain cobalt.

WEAR-FIGHTER! Planes fly farther with fewer repairs, thanks to exhaust valves protected with "Haynes Stellite" cobalt-chromium-tungsten alloys.

UNION CARBIDE AND CARBON CORPORATION

30 East 42nd Street UCC New York, N. Y.

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Haynes Stellite Company
United States Vanadium Corporation

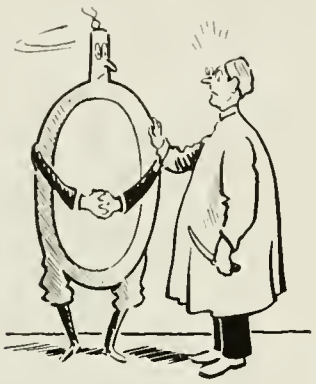
CHEMICALS
Carbide and Carbon Chemicals Corporation

ELECTRODES, CARBONS AND BATTERIES
National Carbon Company, Inc.

INDUSTRIAL GASES AND CARBIDE
The Linde Air Products Company
The Oxweld Railroad Service Company
The Prest-O-Lite Company, Inc.

PLASTICS
Bakelite Corporation
Plastics Division of Carbide and Carbon Chemicals Corporation

G-E Campus News



PLASTIC SURGERY

MISTER FIVE BY FIVE had nothing on radio antenna enclosures until the "doctors" of the G-E Plastics Laboratory (PhD's, not MD's) went to work on the problem of streamlining. The result was a plastic housing that a plane hardly knows it's carrying.

That's just one wartime activity of the Laboratory chemists. They're also concocting plastics for fuse caps on mortar shells and for a vast variety of parts for battleships, tanks, and what-have-you's.

The name "plastics" covers a lot of different materials. These G-E chemists are applying the most precise and ingenious chemical techniques to increase that variety. So, if a special job requires a material with combined properties that no existing material has, they go to work to cook up an entirely new plastic to fill the bill.

The whole story can't begin to be told yet. But when it can, you'll be amazed at how far plastics have gone in wartime, and how many new peacetime jobs they'll be ready to tackle afterward.

PUT A NICKEL IN IT

NICKEL'S gone to war. But that doesn't mean that the juke box and pay telephone will soon be operating on a diet of "wooden nickels" and slugs. For every self-respecting coin-operated machine has a magnet attachment that refuses to accept all coins that do not have the magnetic properties of genuine ones.

So, when a new formula for the five-cent piece was needed in order to save nickel and copper for war service, it had to have magnetic properties close to those of the old-fashioned nickel. A number of metallurgical experts were asked for their advice.

Your guess is as good as the next as to whose advice was finally followed, but the formula submitted by the metallurgical section of the G-E Research Laboratory was pretty close to the one picked. The new "nickel" doesn't *have* any nickel in it, and has lost 19 per cent of its copper—and the metals saved are on their way to hit the Jap-pot.

JAP NAP

ONE night Hirohito had a nightmare. He dreamt that Shangri Las were springing up all over and planes were swarming over him like flies.

Perhaps that nightmare is nearer reality than his Imperial Nibs knows. For now, in practically no time at all, any open field, even though the ground is soft, can be transformed into a hard runway for American bombers starting off to make hay of enemy objectives.

To turn the trick, flexible steel mats are laid along the field. By means of resistance-welding machines guided by G-E electronic tubes, steel bars are automatically joined together to form these mats. The speed far exceeds that of a crew of hand welders.

On some dark night, in some deserted spot, our army engineers will swiftly unload these steel mats, joining them into a smooth, solid runway. And presto! Hirohito's nightmare will become a grim reality. General Electric Co., Schenectady, N. Y.

• • •

Listen to the "Hour of Charm" 10 p.m. EWT Sundays on NBC and the G-E news with Frazier Hunt 6 p.m. EWT Tuesdays, Thursdays, and Saturdays on CBS and American (F-M) networks.

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